12

Mammals of the Bass Strait Islands

By J. H. Hope*

Abstract: Of the 31 native mammals found in Tasmania, 17 are known to be living on the islands of Bass Strait, and six introduced species have established feral populations there. Fossil deposits studied indicate that all but three of the present Tasmanian mammals (excluding the bats) were present on the islands in the past. A cave floor deposit on Flinders Island, dated at the youngest layer at about 8,000 years old. contained the remains of several species, some now extinct on the islands, as well as *Aepyprymnus rufescens,* which has not previously been recorded south of Victoria.

Subfossils recovered from sand blows in the calcareous dunes of the islands are generally the remains of species still extant on the islands, but some species now extinct there have also been found, such as *Sarcophilus harrisii,* on Flinders Island. Pleistocene fossils collected from King Island and northwestern Tasmania early this century have been reviewed. Before European settlement no island of less than 1·4 sq km supported any marsupial herbivore, while two species were found together only on islands more than 6 sq km in area. Since 1800, the populations of mammals on many of the smaller islands have died out.

Most of the species and subspecies endemic to Tasmania are present on the islands as well as in Tasmania. As the sea level fell and land was exposed in Bass Strait, the Tasmanian fauna was able to move north onto the developing land bridge and become established there long before the final connection formed with Victoria. While the land bridge was in existence the boundary between the Tasmanian and mainland faunas lay close to the present Victorian coast.

INTRODUCTION

The islands of Bass Strait are remnants of a land bridge which connected Tasmania to the mainland of Australia at times of low sea level during the Pleistocene. The modern mammalian fauna of the islands is derived from that of the most recent land bridge which broke up about 10,000 years ago (Jennings 1971). In order to understand the present distribution patterns of the island mammals, some reconstruction of the fauna of the land bridge has been made to supplement the survey of the modern fauna. Information on the late Pleistocene fauna of the area was available from fossil deposits discovered early this century on King Island and in northern Tasmania, and during this study an early Holocene bone deposit on Flinders Island was excavated. A survey of subfossils collected from the sand dunes of many islands, considered with the reports of explorers and early visitors to Bass Strait, made possible an assessment of the modern fauna of the islands prior to the effects of European settlement. Over the past 180 years both direct exploitation of the fauna and land development have had a deleterious effect on the island fauna.

ENVIRONMENT

The Islands

Bass Strait separates the island of Tasmania from the Australian mainland by less than 200 km. The islands of the Strait are confined to two rises on the E. and W. while the deepest waters of the Strait lie in the centre. On the eastern margin of Bass Strait a chain of islands runs from the northeastern corner of Tasmania to Wilsons Promontory in Victoria. These granitic islands are generally mountainous, reaching a height of 756 m in the Strzelecki Peaks on Flinders Island. On this island a central granite spine runs from the NE. to the SW. along the island, separating a narrow western and a broad eastern coastal plain. Cape Barren Island, the second largest of the Furneaux Group, is also rugged and reaches a height of 686 m at Mt. Munro. Some of the smaller islands to the north of the Furneaux Group, such as Deal Island, the largest of the Kent Group, and

* Department of Prehistory, Research School of Pacific Studies, Australian National University, A.C.T.

Rodondo and Curtis Islands, off Wilsons Promontory, reach heights of up to 330 m, though they are very small in area. Of the larger eastern islands, only Clarke Island is flat and low. The widest water barrier between the islands of the eastern chain is about 50 km, separating the Kent and Furneaux Groups.

The major island on the western side of Bass Strait is King Island, midway between northwestern Tasmania and Cape Otway, Victoria. In contrast to the eastern islands, King Island is a low plateau, reaching a maximum height of 168 m in the SE. To the SE. of King Island the islands of the Hunter Group lie close to the Tasmanian coast.

Tasmania, with an area of 67,900 sq km, is much larger than any of the Bass Strait islands, the largest of which are Flinders (1,333 sq km) and King (1,100 sq. km.) Tasmania and the islands are physically part of the Australian continent, lying on the continental shelf. Bass Strait is shallow, with an average depth of 60 to 80 m, and a floor of subdued relief, so that a drop in sea level of only 65 m would be sufficient to expose a land corridor along the eastern islands.

Climate

Tasmania and the Bass Strait islands have a temperate maritime climate controlled by the prevailing westerly winds. The following account is derived from Langford (1965) and Bureau of Meteorology (1954, 1966).

Rainfall in Tasmania is highest on the W. coast, rising to an average of over 2700 mm a year, and is lowest in the central and east coast regions where it falls to an average of less than 500 mm a year. A distinct rainshadow operates in the central, eastern and southeastern regions, with a strong precipitation gradient across the central plateau to the adjacent midlands. This rainfall distribution can be attributed to a strong westerly circulation intensified by mountain features.

The rainshadow effect extends N. into Bass Strait, where King Island on the W. has the highest average annual rainfall of all the islands. Here the rainfall ranges from 675 mm in the N. of the island to about 1050 mm in the S. More than three-quarters of the island receives an annual rainfall of more than 850 mm. In contrast, the rainfall of Flinders Island in eastern Bass Strait ranges from 650-875 mm in different areas and is partly orographic. The Strzelecki Range is the wettest area, receiving an estimated average rainfall of 850 mm (unofficial Range figure, Dimmock 1957). Other high areas receive 750-775 mm, while most of the coastal plain receives 725-750 mm a year. Goose Island, 27 km SW. of Whitemark, Flinders Island, has an annual rainfall of 550 mm and it is likely that many of the smaller islands of the Furneaux Group have a similar low rainfall. The western coastal plain of Cape Barren Island has an annual rainfall of 675 mm, but it is probable that the higher areas of this island receive about 775 mm. The only other rainfall station in Bass Strait, on Deal Island in the Kent Group, receives an annual rainfall of 725 mm. The rainshadow effect disappears S. of the Victorian coast, where the higher coastal regions such as Wilsons Promontory and the Otway Ranges have an average rainfall of up to 1375 mm, while the lower coastal districts average 750 mm or less.

The rainfall in Tasmania, the islands of Bass Strait and southern Victoria is well distributed throughout the year, generally with a winter maximum. King and Flinders Islands differ from each other in the number of raindays as well as in average rainfall; King has an average of 212 raindays per year, in contrast with 111 raindays per year on Flinders Island.

Temperature records for Bass Strait are available only for King Island, but it is likely that a similar regime occurs on Flinders Island as well. On King the mean maximum temperature for summer is about 20°C. Extreme maxima are just above 35°C, but days over 32°C are rare. The mean winter temperature is 13°C. Minimum temperatures average 12°C in summer and 7°C in winter. Extreme minima of below 0°C occur occasionally in winter and spring, but frosts are rare and near the sea many years may be frost-free.

The prevailing winds in Bass Strait and Tasmania are from the NW. and SW., and are strongest from the W. From this direction, in the Strait, winds blow with great severity and gales may last for several days with calm spells in between. Northwest winds are stronger and more frequent in winter, while those from the SW. are more frequent from October to February.

Vegetation

The climatic gradient gives rise to some distinctions in the vegetation of the eastern and western islands. Wet sclerophyll forest, locally dominated by *Eucalyptus globulus* originally extended over the SE. of King Island (Green & McGarvie 1971) but has now been completely destroyed by fire. On Flinders and Cape Barren Islands it is restricted to sheltered mountain gullies (Green 1969). Dry sclerophyll forest, dominated by *E. viminalis, E. ovata* and *E. amygdalina,* which generally occurs in areas of less than 750 mm annual rainfall, covers the central hills of the Furneaux Group. Eucalypt woodlands, dominated by *E. ovata* and *E. simmondsii* also occur on

shallow or poor soils on these islands and others of more than 5 sq km. in area. On exposed headlands or calcareous sands *Casuarina stricta* forms extensive woodlands often with a shrubby understory, and this community is a characteristic component of island vegetation extending to the smaller groups such as the Kent, Glennie, and Seal Groups.

Myrtaceous shrublands and various heath communities are widespread on many islands, especially on coastal dune fields or on very poor soils associated with leached sand sheets. Very dense fire-seral shrublands have replaced the original forests and woodlands in many areas. *Melaleuca ericifolia* forms dense thickets on waterlogged ground and these are especially extensive on King Island. Closed *Poa poiformis* tussock grassland is the major community on the smaller or more exposed islands, although it can also be extensive as a coastal belt on the larger islands such as Cape Barren Island. Guiler (1967) has suggested that some smaller islands in the Furneaux Group now vegetated by *Poa* grassland once carried shrublands and woodlands which have been removed by clearing and firing. The vegetation on most islands has been regularly burnt and large areas of Flinders and King Islands have been cleared and pastures established, Green (1969) and Green and McGarvie (1971) have described the modern disturbance of the vegetation on these two islands.

European Settlement

Bass Strait was one of the earliest parts of Australia to be settled during the late 18th and early 19th centuries, attracting a large itinerant population because of the abundant seals on the islands. When the seals were virtually wiped out by the 1830's, many of the sealers remained on the islands, farming, fishing and hunting. The smaller islands of the Furneaux Group were inhabited almost continuously until the 1930's, and are still used for grazing or for the seasonal industry, muttonbirding. The larger islands, Flinders and King, were not inhabited to any great extent until the end of the 19th century, apart from the short-lived aboriginal settlement on Flinders Island in the 1830's (Plomley 1966). Recent War Service Land Development schemes have led to extensive land development on both these islands. The history of land settlement has been given in some detail by Stephens and Hosking (1932) for King I., and by Dimmock (1957) and Pryor (1967a, b) for Flinders I.

PAST CONDITIONS

During the last glacial period of the Pleistocene when the world sea level was somewhere between 100 and 150 m lower than at present, an extensive land bridge, incorporating the islands of Bass Strait, existed between southern Victoria and Tasmania. Jennings (1959b, 1971) has discussed in detail the formation and disappearance of the land bridge.

Although the full extent of Bass Strait may have been land only for a short time at the maximum of the final glaciation, the broad Bassian Rise between Wilsons Promontory and Flinders Island probably remained above sea level for much longer, though it may have been broken for some time during interstadials when the sea level rose. Jennings (1971), applying the glacioeustatic curves of several authorities, has suggested ranges of dates for the postglacial break of the land bridge and the subsequent isolation of the islands from Tasmania, but has stressed the uncertainty of these with respect to possible tectonic movements and erosion and sedimentation in Bass Strait.

At the end of the glaciation, the rising sea would first have broken the connection between King Island and the Otways and then spread into the Bassian Depression between King and Flinders Islands. The break between Victoria and Flinders Island probably occurred between 10,000 and 15,000 years ago, but the bulk of the estimates obtained from using different glacioeustatic curves lies between 12,000 and 13,500 BP. Since this is the period of sharp oscillations in climate and ice limits in the northern hemisphere, it is possible that the sill between Victoria and Flinders Island was flooded then re-exposed at this time, before finally submerging. For the King Island Rise, between King Island and NW. Tasmania, a similar range of dates was obtained, with the preponderance here between 10,000 and 12,500 BP. Similarly the link across Banks Strait, between the Furneaux Group and Tasmania, may have been lost between 8,500 and 10,000 BP.

The sea level rose sharply to reach its present level about 6,000 years ago, but there is some controversy as to whether it has since then remained stationary, oscillated slightly or whether there has been a small but persistent rise. The islands of the Furneaux Group are separated from each other by depths of less than 17 m, so it is likely that many were not isolated from each other until this time. If there has been any oscillation in sea level during the last 6,000 years, then the islands of the Furneaux Group and of the Hunter Group may have been periodically joined and separated. Shifting sand bars and shoals may have complicated this effect; within historical times connections have existed between some

islands in the Furneaux Group and between Robbins and Walker Islands in the Hunter Group.

The temperature in Tasmania during the last glaciation was probably about 5°C lower than at present (Galloway 1965), but there is conflieting evidence as to whether the climate in Australia was wetter or drier at the time. Geomorphological evidence (Davies 1967) suggests that the precipitation gradient across Tasmania was at least as marked during the last glaciation as it is today. If so, it is likely that the rainshadow effeet would have extended north onto the Bassian land bridge, perhaps aeeentuating the present differenee in rainfall between the eastern and western islands. There is evidenee that the elimate was at least effeetively wetter in this region, as Jennings (1959a, 1961) records wood of *Nothofagus* sp. and pollen of *N. cunninghami, Phyllocladus aspleniifolius* and *Drimys lanceolata,* all constituents of the cool temperate rainforest, from a deltaie deposit on King Island dated at 37,500 ± 1900 years BP.

Within Tasmania a 5°C drop in temperature would have brought the tree line down to 500 m above sea level, aceording to Galloway (1965). Sinee Tasmania is mountainous, this would have restricted forest and woodland to a narrow fringe around the coast, the central midlands and the land bridge to the north. In higher arcas towards the permanent snowline, only alpine communities would have survived. Cool temperate rain forest probably extended into lower areas of Tasmania and onto the land bridge. However, areas of dry sclerophyll forest and woodland must have per-sisted during the glaeiation, as five endemic eucalypts are found today in these eommunities in eastern Tasmania (Jaekson 1965). Little definite evidence is available about Pleistoeene vegetation within Tasmania, even though Gill and Banks (1956) have suggested that pollen evidence indicates that an open woodland existed at Mowbray Swamp, in northwestern Tasmania, dated at more than 37,000 years BP.

PLEISTOCENE FOSSILS FROM KING ISLAND AND TASMANIA

King Island (Fig. 1) is a low plateau, largely of metamorphie rocks, with superfieial Cainozoic deposits of limestones, ealcarenites and sand. The main plateau reaches its maximum height of 168 m in the SE., and with its low surface of rolling hills, extends N. for about two-thirds of the island. At the N. of the island, the coastal sand dunes surround a low area of lagoon and swamp land. Jennings (1959a) deseribes in detail the geomorphology of this area, whieh eonsists basically of estuarine-marine deposits overlain in plaees by freshwater and swamp deposits.

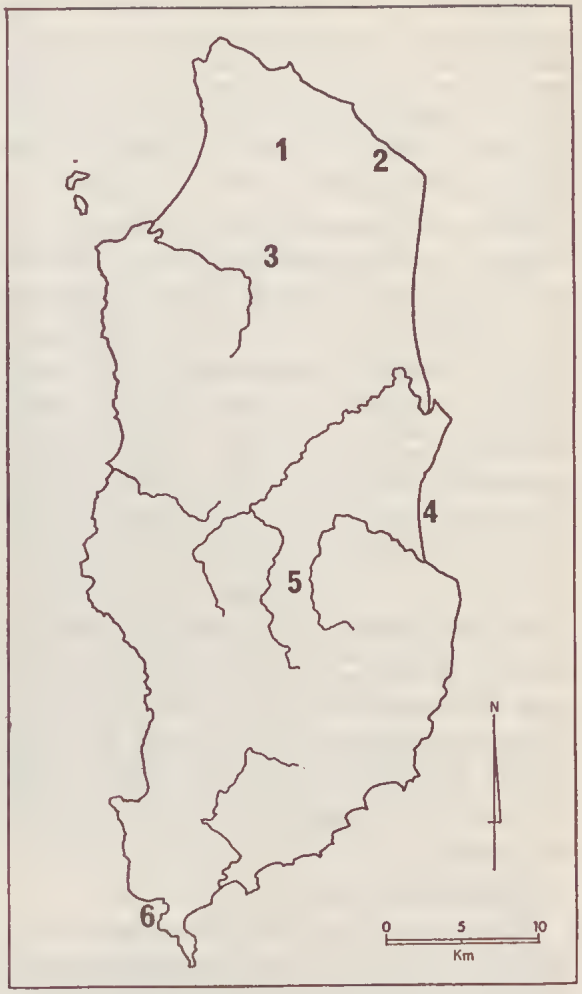

Fig. 1—King Island. 1. Egg Lagoon. 2. The Nook. 3. South East Lagoon. 4. Sea Elephant Bay. 5. Pegarah. 6. Surprise Bay.

In the proeess of draining the two major lakes in this area, Egg Lagoon and South-East Lagoon, early this eentury, several finds of fossil marsupials were made. Scott (1912, 1915a) identified bones from King Island, sent to him by F. H. Stephenson of 'Yambacoona' Station, as *Nototherium victoriae* Owen. Jennings recorded that Mr. H. Graves of King Island had told him that the find was actually made in 1911 by Mr. Graves' brother, at the western end of Egg Lagoon. Further eomments on this material were made by Seott and Lord (1921b, e, d). Keble (1945) deseribed another find from Egg Lagoon of bones attributed to *Diprotodon australis,* made by Mr. J. G. Haynes in 1927. The bones were found scattered along a quarter of a mile of drain in elay underlying blaek swamp soil. This eollection is in the National Museum of Vietoria and ineludes a molar of *D.*

optatum (= *D. australis*) (P14403), skull and mandible fragments of *Protemnodon anak* (P30786) and some unidentified long bones. Jennings (1959a) gave some details of the stratigraphy of peats and clays from the sites of these two finds.

A further collection, made by the surveyor, K. M. Harrisson, has been attributed by Jennings (1959a) to South-East Lagoon, although it is very poorly documented. Scott and Lord (1922c, 1924a, b, c) recorded from this locality *Zaglossus harrissoni* Scott and Lord, *Nototherium mitchelli* Owen, *N. victoriae* Owen and *Macropus anak* Owen, as well as modern wombats, wallabies and kangaroos. Fossil material in the Queen Victoria Museum, labelled 'Harrisson's Collection' includes the modern species *Vombatus ursinus, Thylogale billardierii, Dasyurus maculatus* and probably also *Macropus rufogriseus*. Jennings considered that the freshwater deposits of South-East lagoon and possibly also Egg Lagoon must date back to the formation of the series of older coastal dunes, possibly during the last interglacial period of the Pleistocene.

A similar series of fossils has been collected from Mowbray Swamp in the NW. corner of Tasmania. Here the fossils were recovered from peats overlying an Upper Pleistocene marine sand. In 1910, fossils recovered from Mr. E. C. Lovell's farm were described as a new species, *Nototherium tasmanicum* Scott 1911 (Scott & Harrisson 1911, Scott 1915a, Scott & Lord 1921b, 1922a, 1923, 1924d, 1925a, b, 1926; Noetling 1912). Later *Palorchestes* was recorded from Mowbray Swamp (Scott 1916), as well as *Nototherium mitchelli* (Scott & Lord 1921a, b, c, d, 1922a, 1923, 1925a, b) and *Phascolonus* (Scott & Lord 1925b). The remains of *Vombatus* sp., kangaroo, wallabies and rodents have also been found there (Gill & Banks 1956). Scott (1927) gave a general account of the finds.

Gill and Banks (1956) have written a detailed review of the fossils and have investigated the geomorphology of Mowbray Swamp. They obtained a ^{14}C date of more than 37,000 years BP from peat at the site of discovery of the holotype of *N. tasmanicum*. On the assumption that the large marsupials found here would have been associated with a more open vegetation than the thickets which covered Mowbray Swamp before clearing this century, they suggested that these deposits formed during a period drier than the present. Gill and Banks (1956) also recorded the discovery of extinct species of marsupials from Scotchtown Cave, a few miles from Mowbray Swamp. These include the following: *Nototherium, Thylacoleo, Palorchestes, Sthenurus, Macropus* aff. *titan, Vombatus, Thylacinus, Sarcophilus* and wallaby. Tedford (1966) considered the *Sthenurus* from this deposit to be *Sthenurus occidentalis*.

These records suggested that there were three diprotodontids present on King Island during the Pleistocene (*Diprotodon optatum, Nototherium mitchelli*, and *N. victoriae*) and three present within Tasmania (*N. mitchelli, N. tasmanicum* and *Palorchestes azael*). This led to some zoogeographic speculation, for example by Woods (1962) who suggested that the apparent absence of *Diprotodon optatum* from Tasmania might have been due to the presence of the endemic species *Nototherium tasmanicum*.

However, although no detailed studies have yet been carried out on the collections of Pleistocene material from King Island and Tasmania, some of the above identifications are now known to be incorrect. Most importantly, the holotype of *Nototherium tasmanicum* Scott from Mowbray Swamp (QVM 1965/39/2), has been identified by the late R. A. Stirton as a specimen of *Zygomaturus trilobus* (M. Plane, pers comm.). The specimen described and figured as *Nototherium mitchelli* by Scott and Lord (1921c, d, Plates XIII-XXIII) also seems to be *Z. trilobus*. Stirton (1967) and Woods (1968) have discussed the status of the various described species of *Nototherium*, and it is likely that only one species was represented in the known Pleistocene faunas. Further study of the fossil material from King Island and Tasmania is needed to discover what material is in fact *Z. trilobus* and what, if any, is attributable to *Nototherium*. Pending this, the record of *Nototherium* for King Island and Tasmania is retained here.

As *Zygomaturus trilobus* is found throughout southern Australia in Pleistocene deposits, and *N. inerme, Diprotodon optatum*, and *Palorchestes azael* are also well represented in the mainland Pleistocene faunas, it seems that, unless further fossil discoveries prove otherwise, the Pleistocene marsupial fauna of Tasmania and King Island included no species peculiar to that area. This leaves *Zaglossus harrissoni* as the only fossil mammal which can be considered endemic to the Pleistocene of Tasmania. It is represented, however, only by one femur, and a revision of Pleistocene species of *Zaglossus* throughout Australia is likely to show that this King Island species is no different from the mainland ones.

RANGA CAVE, FLINDERS ISLAND

Pleistocene aeolian calcarenites occur over much of the W. coast of Flinders Island and have been described in detail by Sutherland and Kershaw (1971). A cave is developed in the limestone of

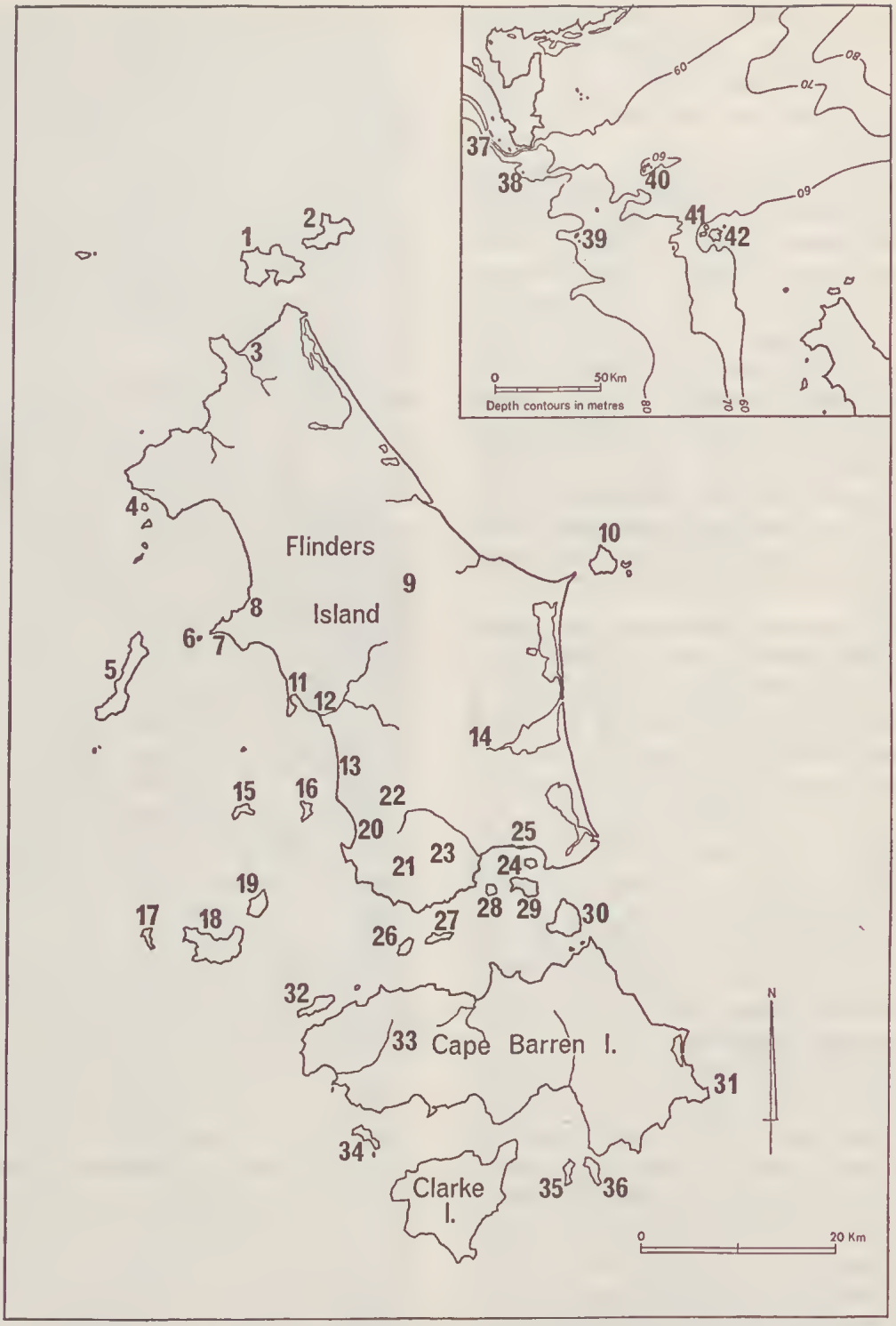

FIG. 2—Islands of eastern Bass Strait. 1. West Sister I. 2. East Sister I. 3. Palana. 4. Roydon I. 5. Prime Seal I. 6. Wybalena I. 7. Settlement Point. 8. Emita. 9. Memana. 10. Babel I. 11. Blue Rocks. 12. Pats River. 13. Whitemark. 14. Laekrana. 15. Big Green I. 16. East Kangaroo I. 17. Goose I. 18. Badger I. 19. Mt. Chappell I. 20. Locotta. 21. Strzeleeki Peaks. 22. Ranga Cave. 23. Smiths Gully. 24. Little Green I. 25. Lady Barron. 26. Woody (Anderson) I. 27. Tinkettle I. 28. Little Dog I. 29. Big Dog I. 30. Vansittart I. 31. Cape Barren. 32. Long I. 33. Mt Munro. 34. Preservation I. 35. Forsyth I. 36. Passage I. 37. Glennie Group. 38. Rodondo I. 39. Curtis I. 40. Hogan Group. 41. Erith I. 42. Deal I.

a dune at Barclay's Hill, near Ranga in the south of Flinders Island (Fig. 2). This cave, here called Ranga Cave, has long been known on Flinders Island; several bones recovered from its floor were sent to the Queen Victoria Museum in 1917 by F. Henwood and L. L. Waterhouse (Scott & Lord 1922b). These consisted of the remains of *Vombatus ursinus, Macropus rufogriseus, Potorous tridactylus* (= P. *apicalis*) and *Trichosurus vulpecula,* as well as a phalange of the fur seal, *Arctocephalus tasmanicus* (= *A. doriferus*) (Sutherland & Kershaw 1971).

The calcarenite dune at Ranga is on the western side of the island and fills a valley between granite hills, lapping onto the foothills of the Strzelecki Peaks. The cave is developed in the steep north bank of a creek running W. between the granite range to the S. and the limestone to the N. At this point the hillslope is gentle enough to maintain a soil cover and is vegetated in areas between limestone outcrops, but further W. a sheer walled gorge is developed. No other caves are known from Flinders Island, but several sinkholes occur above the cliffs to the W. of Ranga Cave. Sinkholes have been known to open up after heavy rain elsewhere on the property at Barclays Hill which includes the limestone dune.

Ranga Cave is about 45 m above sea level and 12 m above the present creek. It consists of a single domed chamber, extending in an E.-W. line for 22·5 m and it averages 9 m in width. At the eastern end an extension adds another 7·5 m in length. The extension appears to be a cavity amongst fallen blocks of limestone that is now isolated from the main cave by the formation of a wall and roof of calcite about 2 m high. Ranga Cave has a low narrow entrance at floor level on the S. side of the cave. Within the main chamber several large pillars extend from floor to ceiling, and stalactites and stalagmites are common. The walls and formations are covered with wet milk calcite. The floor of the cave is earthen, covered in places by a thin layer of calcite and large pieces of fallen stalactite. The floor slopes from W. to E., falling about 2 m in the length of the cave. Entry to the small extension is gained through a hole in the rock shelf acting as its roof, and beyond it the eastern end of the cave is blocked by fallen rocks. At the western end a narrow passage about half a metre high leads off from the cave. By excavating the floor it was possible to crawl about 10 m. The passage then expanded into small chambers and branched in all directions.

Animal remains collected from Ranga Cave came from two sources. The remains of smaller animals, mainly rodents, were recovered from crevices within the isolated extension. These were generally well preserved skulls and undamaged long bones. Some were coated with or cemented together by calcite. In contrast the bone material recovered from excavation in the floor of the main part of the cave consisted of both large and small species and was very fragmented.

Altogether four pits were dug in the floor, three at the lower eastern end of the cave and one at the western end. The section in Table 1 describes the deposit at the eastern end of the cave. In the most easterly pit the large rocks appeared at a depth of 60 cm and there was no observable change from red to brown earth. In the pit at the western end of the cave, a similar sequence to that in Table 1 was observed. Although the top of this pit was about 2 m higher than those excavated at the eastern end, the width of each layer in the deposit was much the same, and it appeared that the sediments dipped from west to east following the slope of the floor. Very little bone was recovered from the eastern pit.

Because of the floor slope, it would seem that the floor material with its bone and abundant charcoal had been washed into the cave from the western end. No pollen was found in the deposit. There was a change at 60 cm from an upper red earth to a lower brown one. At that point the quantity of quartz and mineral sand decreased from about 50 % (by volume) to about 25%, and there was a very low amount of carbonate in soil samples in the brown earth. Charcoal and to a lesser extent bone was concentrated in the red earth and

TABLE 1

PROFILE OF EXCAVATION AT RANGA CAVE, FLINDERS ISLAND

Description	*Depth*
1. Compact dark brown layer	0-1 cm
2. Very light yellow layer with abundant bone fragments and charcoal. Carbon-14 date on charcoal from this layer is 8,110 ± 340 BP (GaK 1300).	1-2 cm
3. Loose dry red earth, with abundant bone fragments and charcoal. A few small rocks of limestone. Carbon-14 date from charcoal in the top 15 cm of this layer is 8,200 ± 120 BP (GaK 1301).	2-60 cm
4. Wet brown earth, very little charcoal, many bone fragments. Large irregular rocks and pieces of stalactite.	60-90 cm
5. Large limestone boulders, with wet brown earth between. Unknown depth.	90-180 cm

surface layers and it was impossible to collect enough charcoal for a radiocarbon date from the brown earth. The two radiocarbon dates obtained from the upper layers are listed in Table 1.

Bone was recovered from the floor by drying the excavated earth and then sifting it. Almost all the bone collected from here was very fragmented, consisting of small chips and isolated teeth. The type of bone fragmentation is the same as that found by Douglas, Kendrick and Merrilees (1966) in a bone deposit near Perth, W.A., and interpreted by them to be due to predation by the Tasmanian devil, *Sarcophilus harrisii*. Although this species is not represented in the cave deposit and has not been recorded alive on Flinders Island, it has been found as a subfossil there. The bones recovered from the small extension are less fragmented and may represent animals that had fallen into the cave from some old opening to the surface. Identifications are generally based on teeth, and because of the fragmentation identifiable material was rare. All species recorded from the excavated pits were collected both in the red and brown layers, but no estimate of the relative abundance at the different levels was possible. Most of the animals in the deposit were either juveniles or aged specimens, as shown by the state of eruption and wear of the teeth.

The mammal species fall into three categories:

a. Those which are found on Flinders Island at present. All of these are part of the modern Tasmanian fauna. These are *Macropus rufogriseus, Thylogale billardierii, Vombatus ursinus, Potorous apicalis, Trichosurus vulpecula, Pseudocheirus peregrinus, Rattus lutreolus* and *Antechinus minimus*.

b. Those which have never been recorded alive on any of the Bass Strait islands, but which are still present in Tasmania. These are *Macropus giganteus, Perameles gunnii, Dasyurus viverrinus, Mastacomys fuscus* and *Pseudomys higginsi*.

c. Those which have never been recorded alive from either the islands or Tasmania. These are *Aepyprymnus rufescens and Pseudomys* cf. *novaehollandiae*. The latter has been recorded from a cave deposit at Flowery Gully, Tasmania, dated at 7080 ± 420 years BP (Green 1967, Gill 1968) and it may be that *Aepyprymnus* is also represented in the fossil Tasmanian fauna, but it has not yet been recorded. Both these species are represented in cave faunas of southern Victoria but *Aepyprymnus* was last recorded alive there during the 19th century (Wakefield 1964). Although *Pseudomys novaehollandiae* was also thought to be extinct in Victoria, a small colony has recently been discovered on the Mornington Peninsula (Seebeck & Beste 1970).

The final separation of the eastern Bass Strait islands from Tasmania probably occurred some time between 8,500 and 10,000 years ago (Jennings 1971), after the islands had already been cut off from Victoria. The age of the topmost layers of the deposit at Ranga Cave is about 8,000 years BP and it is probably that the deposit accumulated over at least several hundred if not some thousands of years. So the species found in the deposit represent a selection of the fauna of the eastern side of the Bassian peninsula at the time of sea level rise and island formation. This fauna appears to have been largely the same as that of Tasmania today. There are only two additional species represented which do not now live in Tasmania and one of these is known as a fossil from Tasmania.

SUBFOSSILS FROM THE ISLAND SAND DUNES

As with much of the southern and western coasts of Australia, aeolian calcarenites are found on many of the islands of Bass Strait. In many places unconsolidated sand dunes overlie the limestones, and where blowouts occur in these dunes, accumulations of the bones of mammals and birds have often been exposed. Flinders (1814 p. cxxxii) described one of these blowouts on Preservation Island in the Furneaux Group as 'remarkable for the quantity of bones of birds and small quadrupeds, with which it was strewed'.

The extensive dune systems attracted the attention of members of the several Victorian Field Naturalists' expeditions to Bass Strait, and in the 1880's subfossils were collected from King and Deal Islands. Later Spencer and Kershaw (1910a) described an extensive collection from Stokes Point on the extreme SW. corner of King Island. Similar deposits have now been found in sand blows on Flinders and Cape Barren Islands, as well as on several of the smaller islands of the Furneaux Group. In comparable coastal sand dunes in Victoria and Tasmania, Aboriginal midden material has been found (Coutts 1967, Jones 1968), but there are no indications of the presence of Aborigines, such as broken and burnt shells and charcoal, in the island dunes. However, one stone implement has been collected at Palana, and a few others found elsewhere in the Furneaux Group (R. Jones, pers. comm), although the islands were not inhabited by Aborigines when they were first visited by European explorers.

Jennings (1968) has discussed the distribution and formation of calcarenites in southern Australia, with particular reference to Bass Strait. Here, on the larger islands the west coast dunes are predominantly calcareous, ranging from unconsolidated shell sand to a typical calcarenite, while those on the eastern coasts consist mainly of quartz sand. On King Island Jennings (1959a) distinguished new and old dune systems. The latter are mainly siliceous, consisting of deeply leached white sand, often overlying a humus-bound sand rock. Calcareous old dunes on the western side of King Island occur down to sea level. Calcarenite exposed within new dunes may belong either to the new dune or to the underlying old dune. Kershaw and Sutherland (1971) have found a similar pattern in the dune systems of Flinders Island, but suggest that there the old dunes could comprise up to five series of different ages. There is no agreement as to whether the present coastal dune systems formed during the glacial periods, when the sealevel was lower than at present, or during periods of high sealevel, that is, interglacials and interstadials. Jennings (1959a) considered that the immaturity of the soil profile of the new dunes on King Island indicates that they are Holocene, while he places the old dunes in the last interglacial on the evidence of high sealevel features. The dunes on Flinders I. are probably of similar and older ages. Fossil marsupials have been recovered from both calcarenites and from blowouts in unconsolidated sands.

King Island

The list of species recorded from the King Island sand dunes (Table 2) has been compiled from Spencer and Kershaw (1910a), Scott (1905, 1906, 1917) and Anderson (1914), as well as from the extensive collections in the National Museum of Victoria, the Tasmanian Museum, Hobart, and the Queen Victoria Museum, Launceston.

The first fossil specimen from Surprise Bay, King Island, was identified by Scott (1905) as *Macropus anak* Owen. At the same locality, Scott also recorded specimens which he first called *'Procoptodon'* (Scott 1906) but later identified as *Sthenurus atlas* (Scott 1917). Anderson (1932) considered this to be *Sthenurus occidentalis*, and Tedford (1966) agreed with this identification. According to Scott (1905) these fossils were 'embedded in a soft friable (shell) limestone rock, of marine origin'. Jennings (1959a) interpreted this matrix as calcarenite. These two species described by Scott seem to be the only ones recovered from calcarenites and sand dunes on the islands that were certainly extinct before Europeans arrived in Bass Strait in 1797.

The collections of Spencer and Kershaw, and most of the material in museum collections consist of the remains of animals still alive on King Island today, or which have only recently become extinct there. These specimens were not embedded in calcarenite, but were found scattered throughout unconsolidated sand dunes. Of these *Vombatus ursinus* and the King Island emu *Dromaius ater* were seen alive by French naturalists in 1802 (Péron & Freycinet 1816 p. 13), but had apparently died out on the island by the time of the 1887 Field Naturalists' expedition (Campbell 1888). Spencer and Kershaw (1910a) also described an endemic species of tiger cat, *Dasyurus bowlingi*, from the subfossil material of King Island. This is not in fact specifically distinct from *Dasyurus maculatus* (Marshall & Hope 1973).

Apart from these species, and *Pseudomys higginsi*, which has never been recorded alive from King Island but may possibly still survive in the wet gullies in the southeast of the island, all other species listed in Table 2 are still extant there.

Furneaux Group

Although calcareous dunes extend down much of the W. coast of Flinders Island, most of them are stabilized. The only extensive sand blow is at Palana on the north coast, from where the largest collection of subfossils has been recovered. This blowout is evidently very old, as sand hills are marked at Palana on the Admiralty Charts compiled by Stokes between 1839 and 1842, before Flinders Island was leased for settlement. However new areas at Palana are now actively eroding due to cattle grazing.

The Palana blow extends for about 3 km along the coast. A thin limestone band runs through the sand dunes, and Kershaw and Sutherland (1971) consider that this outlines the profile of older dunes lying beneath the superficial unconsolidated sands. This thin layer which dips from E. to W. is partly eroded through at the western and older end of the blow, where the floor of the sand blow, except for a low fore-dune, is almost continuous with the modern beach, and slopes gently upwards away from the shore. Here driftwood and marine shells are intermixed with mammal and bird bones. Towards the E. the blowout is more recent, and has uncovered the limestone layer at about 9 m above sea level. Large boulders of Palana Limestone (calcarenite) outcrop in the

TABLE 2

SPECIES RECORDED FROM THE SAND DUNES OF THE ISLANDS OF BASS TRAIT

K —King I.
F —Flinders I.
C —Cape Barren I.
Ps —Passage I.
Pr —Preservation I.
Ka —East Kangaroo I.
D —Deal I.
E —Erith I.
T —Three Hummock I.

Species	K	F	C	Ps	Pr	Ka	D	E	T
TACHYGLOSSIDAE									
Tachyglossus aculeatus	+	+	-	-	-	-	-	-	-
DASYURIDAE									
Antechinus minimus	+	?	-	-	?	-	?	-	-
Dasyurus maculatus	+	+	+	-	-	-	?	-	-
Sarcophilus harrisii	-	+	-	-	-	-	-	-	-
PERAMELIDAE									
Isoodon obesulus	-	+	+	+	-	-	-	-	+
PHALANGERIDAE									
Trichosurus vulpecula	-	-	-	+	-	-	+	+	-
PETAURIDAE									
Pseudocheirus peregrinus	+	+	+	-	-	-	-	-	-
VOMBATIDAE									
Vombatus ursinus	+	+	+	-	-	-	+	-	-
MACROPODIDAE									
Potorous apicalis	+	+	+	-	-	-	+	-	+
Thylogale billardierii	+	+	+	+	-	+	+	+	+
Macropus rufogriseus	+	+	+	-	+	-	+	+	-
Macropus giganteus	-	-	-	-	-	-	?	-	-
Protemnodon anak	+	-	-	-	-	-	-	-	-
Sthenurus occidentalis	+	-	-	-	-	-	-	-	-
MURIDAE									
Rattus lutreolus	+	+	+	+	+	-	+	+	-
Pseudomys higginsi	+	-	-	-	-	-	-	-	-
OTHERS									
Dromaius ater	+	-	-	-	-	-	-	-	-
Puffinus tenuirostris	+	+	+	+	+	+	+	+	-
Cereopsis novaehollandiae	-	-	-	-	+	+	-	-	-
Tiliqua nigrolutea	?	+	+	+	+	-	+	+	-
Cattle/Sheep	+	+	+	+	+	+	-	+	-
Rabbit	-	-	-	-	-	+	-	+	-
Seal	?	-	+	-	+	-	-	-	-

sand below the limestone layer about halfway along the blow, and other outcrops occur further to the E.

Almost all the mammals and birds represented in the sand blow are present on Flinders Island today. *Dasyurus maculatus* and *Potorous apicalis* are now very rare, and another two species are not now present on Flinders Island. One of these, *Isoodon obesulus*, exists in Bass Strait only on West Sister Island about 6 km N. of Palana. The other species is *Sarcophilus harrisii*, which has not been recorded from elsewhere in Bass Strait, though it is still common in Tasmania. The only notable absence from the collection is *Trichosurus vulpecula* which is very common on Flinders Island today.

On the east coast of Cape Barren Island blow-outs exist at Cape Barren and at Harleys Point, about 12 km to the N. At the former locality the eroding sand ridges run along an E.-W. axis, parallel to the S. coast of the island. Although on the E. coast of the island, they are calcareous, and there are many calcified rootlets in the dunes. The species collected from this sand blow are much the same as on Flinders Island. *Isoodon obesulus* and *Potorous apicalis* have not been recorded from Cape Barren Island before, and it is possible that they are both still extant, as the island has been little explored. *Vombatus ursinus* is now extinct on Cape Barren Island, and *Trichosurus vulpecula*, absent from the sand blow here as on Flinders Island has never been recorded from Cape Barren Island.

At Harleys Point very fragmented bones of seal and of *Thylogale billardierii* were collected. These were stained a deep red colour, in contrast to the bones from the Cape Barren sand blow which were bleached white.

Two small islands to the S. of Cape Barren, Passage and Forsyth Islands, are both dissected by sand blows. The animal bones collected from Passage are listed in Table 2. Particularly notable is the presence of *Trichosurus vulpecula*, which has not been collected from the dunes of the three larger islands. It is unlikely that any large mammals are still extant on Passage Island.

Although Preservation Island is well vegetated, there are two small areas of erosion from which bones have been collected. Preservation is the only one of the smaller islands of the Furneaux Group from which the remains of *Macropus rufogriseus* have been collected.

A collection of thylogale skulls from Kangaroo (East Kangaroo) Island was made by J. A. Kershaw in 1909. These specimens, now in the collection of the National Museum of Victoria are

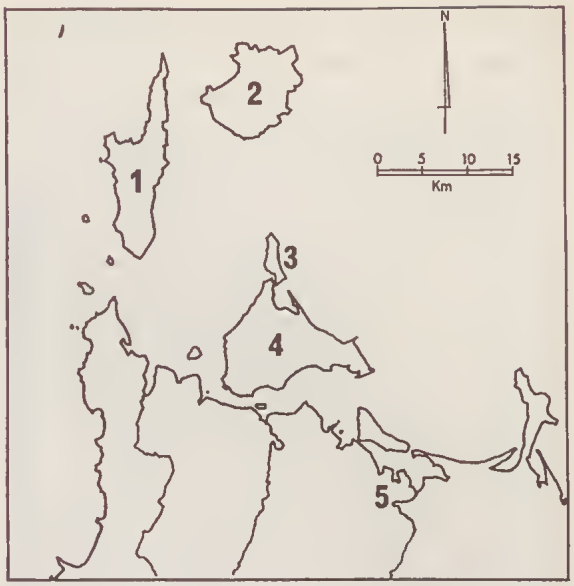

FIG. 3—Hunter Group. 1. Hunter I. 2. Three Hummock I. 3. Walker I. 4. Robbins I. 5. Mowbray Swamp.

labelled as coming from a 'sand blow, formerly timbered hill'. Barrett (1918 Vol. 2, p. 126) described this extensive sand blow on Kangaroo Island in 1909. It contained seal and sheep bones, as well as wallaby.

Seal bones, probably of the fur seal, *Arctocephalus doriferus*, which once inhabited the smaller islands of the Furneaux Group, have been found on Roydon Island. No remains of terrestrial mammals have been collected.

HUNTER GROUP

The islands of the Hunter Group (Fig. 3) are the only ones in Bass Strait known to have been visited by the Tasmanian Aborigines. Flinders (1814) recorded several deserted fireplaces on Three Hummock Island and Meston (1936) gives an account of Aboriginal middens on the islands of the group. He mentions that bones of marsupials and birds were found in the sand blows, associated with shells. The collections of the National Museum of Victoria include bones of *Thylogale billardierii*, *Isoodon obesulus* and *Potorous apicalis*, labelled '3 Hummock Island', and dated 24.11.08-9.12.08, the dates of the A.O.U. expedition to Bass Strait (White 1909).

KENT GROUP

The Kent Group lies to the N. of Bass Strait, between the Furneaux Group and Victoria. The first subfossils from these islands were collected by members of the expedition run by the Field Naturalists' Club of Victoria in 1890 (Le Souef

1891). At Winter Cove on the eastern side of Deal Island, many bones were found loose on the floor and protruding from the walls of a gully. Le Souef recorded the marsupials *Thylogale billardierii* and *Macropus giganteus* from this gully, but most of the remains were bird bones. Spencer and Kershaw (1910a) recorded as subfossils from Deal Island, *Vombatus ursinus* and a tiger cat, which they thought to be similar to the species *Dasyurus bowlingi* they had described from the sand blows on King Island. Neither of these two latter species, nor *Macropus giganteus* has ever been recorded alive from the Kent Group. No specimen of *Macropus giganteus* or *Dasyurus maculatus* from Deal Island could be found in the National Museum of Victoria which houses the collections of Spencer and Kershaw and of the Field Naturalists' Club expeditions. The museum collection does contain specimens of *Thylogale billardierii*, *Macropus rufogriseus*, *Trichosurus vulpecula* and *Vombatus ursinus* labelled as coming from Deal Island and donated by J. A. Kershaw in 1909 and Stephenson in 1903.

Further subfossil remains have now been recovered from the valley at Winter Cove on Deal Island, and are listed in Table 2. Of these only *Macropus rufogriseus* and *Trichosurus vulpecula* are certainly still present on the island. The status of *Rattus lutreolus* and *Antechinus minimus* is unknown, but these two may still be present and the remainder are definitely extinct on Deal Island. However, it is likely that *Thylogale billardierii* at least was still alive at the time of European settlement of the islands, as G. A. Robinson in 1831 recorded both 'wallaby' (*T. billardierii*) and 'kangaroo' (*M. rufogriseus*) on Deal (Plomley 1966).

The valley is an erosion gully in a stabilized and partly consolidated sand dune. The actively eroding head of the gully is about 90 m above sea level, and the gully runs about 330 m downhill, parallel to the beach at Winter Cove at this point, then joins at right-angles a creek emptying into Winter Cove. Le Souef (1891) estimated that the gully extended about 200 yds down to the beach, so even allowing for some error in his estimate, the gully has probably grown in the last 75 years. At the head of the gully the walls are sheer, and here about 2 m of sandy soil overlies cross-bedded aeolian sands. Bones of *Puffinus tenuirostris*, *Macropus rufogriseus*, *Rattus lutreolus* and *Antechinus minimus* were collected from the walls of the gully. The bird bones and also eggshells were the most common. Bones protruding from these upper walls were rare and widely scattered, but lower down the hill, where the sides of the gully are less steep and are vegetated, bones were found concentrated in pockets on the floor of the gully, undoubtedly washed down from above. The only remains of *Potorous apicalis* found were recovered from here.

A small sand blow exists on Erith Island and from this have been collected the bones of *Macropus rufogriseus*, *Thylogale billardierii*, *Trichosurus vulpecula*, *Rattus lutreolus* and *Oryctolagus cuniculus*. As well as occurring loose in the sand, bones have also been found cemented in calcarenite, a piece of which containing embedded bird bones was collected from Erith Island in 1965 by R. Truscott, and is now held in the National Museum of Victoria.

From a small sand blow on Hogan Island, 35 km NW. of Deal Island, the bones of *Rattus lutreolus* and the muttonbird, *Puffinus tenuirostris* have been collected.

Age and Significance of the Subfossils

All the subfossil material at Palana was found either on top of the limestone layer, which in places extends inland as a flat platform, or in sand on the shoreward side of the dunes, in positions that could be accounted for by wind action. Deposits in unconsolidated sands from all islands seem to fit in with this. If so this material is postglacial in age. The species found embedded in limestone on some islands may date back to the last glacial period of the Pleistocene; the two species so found on King Island are in fact now extinct throughout Australia and are known only from Pleistocene and early postglacial deposits. The remains found in the loose sands may be quite old, however; dune midden deposits on the Victorian coast, which include marsupial bones, have been dated back to 6,000 years BP (Coutts 1967, Gill 1967). On the other hand at least some of the material is very new, for example the remains of introduced sheep and cattle, and the occasional skeleton of an obviously recently dead animal. It has been impossible to distinguish between older and more recent bones, as fragility of the bones seems only to indicate the degree of exposure to weathering. Exposed bones of introduced species in some cases were found to be more brittle and weathered than bones of species now absent or rare.

Why did so many bones accumulate in these dunes? Campbell (1888), who accompanied the Field Naturalists' expedition to King Island and visited the sand blow at Seal Bay, suggested that the animals were driven out on to the dunes by fire and perished there. Spencer and Kershaw (1910a) considered that this area had been one

of the most fertile on the island, before the introduction of sheep, and that it had consequently been a feeding ground for large numbers of animals. The sand dunes at Palana are certainly frequented by large numbers of marsupials today, judging by the numerous runs through both the vegetated and blowing dunes, and the many water holes scratched out just above the high tide mark.

It is possible that local catastrophes may have caused the death of a large number of animals at particular times. The large numbers of skulls of *Thylogale billardierii* and *Macropus rufogriseus* collected from the sand dunes on King Island may be due to the slaughter of these species during the early years of the 19th century, when thousands of these animals were killed on the islands. Several of the skulls of *Thylogale billardierii* in the National Museum of Victoria collection of subfossil material from King Island have been cut in half sagittally or have the back of the skull removed. Others show small round holes consistent with damage caused by shot pellets. These may be animals killed by sealers. However this still does not explain the presence in these deposits of smaller species which were not hunted.

Bones of the muttonbird, *Puffinus tenuirostris*, are particularly common in the sand blows of the islands, and it is possible that many of the blows have been initiated by the burrowing of these birds. Bones of birds and rodents are common in the disturbed sand around present day rookeries. It is possible that the dune at Palana at one time maintained a muttonbird rookery although none is there now. Only one small rookery, at Settlement Point, is known to exist on Flinders Island, while the large rookeries in the Furneaux Group are found on the smaller islands, notably Green, Babel, Great Dog and Mt Chappell Islands. In contrast, King Island, which has only three small islets nearby, supports several large rookeries along its coasts.

Whatever the reason for the deaths of so many animals in these areas, the calcareous dunes have obviously provided an ideal environment for the preservation of bone. It is probable that the accumulation of animal remains has continued from the very start of the formation of the dunes. The apparent abundance of subfossils in some blows, particularly those at Palana and on King Island, may be due merely to the accumulation of bones originally scattered sparsely through a sand dune. As the wind blows the sand into parabolic dunes, the heavy bones will tend to stay in place and accumulate on the floor of the blowout. Thus bones of different ages tend to be brought together.

DISTRIBUTIONAL DATA FOR THE MAMMALS

Sources

The following information on the distribution of mammals on the Bass Strait islands has been derived from several sources. Records for many islands are available in the journals of early explorers such as Flinders (1801, 1814) and Péron & Freycinet (1807-1816). Scott (1828) recorded information from James Campbell, boatman, on the islands and their fauna. Another important early source is the journals of George Augustus Robinson who travelled extensively in Bass Strait between 1830 and 1835, and who was responsible for the establishment of the settlement of Tasmanian Aborigines on Flinders Island in the 1830's (Plomley 1966). Towards the end of the 19th century the Field Naturalists' Club of Victoria held expeditions to King Island (Campbell 1888), the Kent Group (Le Souef 1891) and the Furneaux Group (Gabriel 1894). As the emphasis of these expeditions was on the avifauna of the islands, few records of mammals were made. At about the same time, several naturalists, including Atkinson (1890) and Ashworth and Le Souef (1895), visited the islands of the Hunter Group. In November-December 1908 the Australian Ornithologists' Union organized an expedition to the islands of Bass Strait (White 1909), and this was followed by an expedition to the eastern islands in January 1909 (Barrett 1918). Further notes on the mammal fauna of the islands have been made by Le Souef (1929), Green (1969), Green and McGarvie (1971) and Whinray (1971).

Between 1965 and 1968 I visited 11 of the 35 islands larger than 0·8 sq km in Bass Strait; these included all the major islands except those of the Hunter Group. Trapping for smaller mammals was carried out on Flinders, King, Cape Barren, Clarke, Deal and Hogan Islands. All material collected during this study has been housed in the collections of the National Museum of Victoria, and specimens referred to are from these collections unless prefixed by abbreviations of other institutions. These are as follow:

AM Australian Museum, Sydney
QVM Queen Victoria Museum, Launceston
SAM South Australian Museum, Adelaide

Systematic Account of the Mammals

A list of the mammals of Tasmania and the islands of Bass Strait is given in Table 3. Both living and extinct species, native and feral, are included, though some exotic species have been excluded, where they are apparently no longer

TABLE 3
MAMMALS OF TASMANIA AND THE ISLANDS OF BASS STRAIT

+ Extant
N Present until at least 1800; no recent records
F Fossil record only
I Introduced
V Visitor
— No record

SPECIES	Aust.	Furn. Gp.	King I.	Tas.
ORNITHORHYNCHIDAE				
Ornithorhynchus anatinus	+	-	+	+
TACHYGLOSSIDAE				
Tachyglossus aculeatus	+	+	+	+
Zaglossus harrissoni	-	-	F	-
DASYURIDAE				
Antechinus minimus	+	+	+	+
Antechinus swainsonii	+	-	-	+
Sminthopsis leucopus	+	+	-	+
Dasyurus viverrinus	+	F	-	+
Dasyurus maculatus	+	N	N	+
Sarcophilus harrisii	F	F	-	+
THYLACINIDAE				
Thylacinus cynocephalus	F	-	-	N
PERAMELIDAE				
Isoodon obesulus	+	+	-	+
Perameles gunnii	+	F	-	+
VOMBATIDAE				
Vombatus ursinus	+	+	N	+
Phascolonus sp.	F	-	-	F
BURRAMYIDAE				
Cercartetus nanus	+	+	+	+
Cercartetus lepidus	F	-	-	+
PETAURIDAE				
Petaurus breviceps	+	-	-	I
Pseudocheirus peregrinus	+	+	+	+
PHALANGERIDAE				
Trichosurus vulpecula	+	+	+	+
THYLACOLEONTIDAE				
Thylacoleo sp.	F	-	-	F
DIPROTODONTIDAE				
Palorchestes azael	F	-	-	F
Nototherium sp.	F	-	F	F
Zygomaturus trilobus	F	-	F	F
Diprotodon optatum	F	-	F	-

SPECIES	Aust.	Furn. Gp.	King I.	Tas.
MACROPODIDAE				
Aepyprymnus rufescens	+	F	-	-
Bettongia gaimardi	N	-	-	+
Potorous apicalis	+	+	+	+
Thylogale billardierii	N	+	+	+
Macropus rufogriseus	+	+	+	+
Macropus giganteus	+	F	-	+
Macropus titan	F	-	-	F
Protemnodon anak	F	-	F	F
Sthenurus occidentalis	F	-	F	F
PTEROPODIDAE				
Pteropus poliocephalus	+	V	V	V
VESPERTILIONIDAE				
Nyctophilus geoffroyi	+	+	+	+
Nyctophilus timoriensis	+	-	-	+
Eptesicus pumilus	+	+	-	+
Pipistrellus tasmaniensis	+	-	-	+
Chalinolobus gouldii	+	-	-	+
Chalinolobus morio	+	-	-	+
MURIDAE				
Hydromys chrysogaster	+	+	-	+
Rattus lutreolus	+	+	+	+
Rattus rattus	I	I	I	I
Rattus norvegicus	I	-	-	I
Mus musculus	I	I	I	I
Pseudomys higginsi	F	F	F	+
Pseudomys novaehollandiae	+	F	-	F
Mastacomys fuscus	+	F	-	+
FELIDAE				
Felis catus	I	I	I	I
LEPORIDAE				
Lepus europaeus	I	I	-	I
Oryctolagus cuniculus	I	I	-	I
SUIDAE				
Sus scrofa	I	I	-	-
CERVIDAE				
Cervus dama	I	-	-	I

present on the islands in a feral state. A few Tasmanian species have not been recorded from the islands, but these are included for the sake of completeness. Marine mammals did not form part of this study.

The specific status of many populations of Australian mammals is uncertain, and the insular populations of Tasmania and the Bass Strait islands are particularly in need of study. Species names in this paper follow the taxonomy given by Ride (1970). Trinomials are not included in Table 3, but the subspecific status of the island populations is given in the following accounts.

Ornithorhynchidae

Ornithorhynchus anatinus (Shaw and Nodder) 1799

Campbell (1888) recorded that one platypus was seen in the Etterick River, on King Island, by the Field Naturalists' Club expedition to the island. Green and McGarvie (1971) note that some are still known to occur there, mostly on the eastern side. Alliston (1966 p. 109) recorded seeing one on Three Hummock Island in the Hunter Group. No other records or museum specimens from Bass Strait are known to exist.

Tachyglossidae

Tachyglossus aculeatus (Shaw and Nodder) 1792

The echidna, recorded on Flinders Island by Le Souef (1929), is still fairly common there. It occurs there in several colour varieties, ranging from cream to brown. Péron & Freycinet (1807-16) recorded the echidna on King Island in 1802. Campbell (1888) noted that it was plentiful on King Island in 1887, and that the Field Naturalists' expedition collected several specimens. Green and McGarvie (1971) say that it is still present on the island. Flinders (1814 p. cxxxv) recorded that the echidna was seen on Cape Barren Island, but not on any other of the Furneaux Group that he visited. It is still present on Cape Barren I.; I saw one on the E. coast, near Harleys Point, in December 1966. It has not been recorded from any of the smaller islands, nor from the Kent or Hunter Groups. The island echidnas are the Tasmanian subspecies, *T. aculeatus setosus* (Geoffroy).
Specimens: Flinders I.: C5607-10. King I.: C5621.

Zaglossus harrissoni (Scott and Lord) 1922

This extinct species of *Zaglossus* has been recorded only from King Island, associated with other elements of the Pleistocene fauna there (Scott & Lord 1922b, 1924c). Living members of the genus are restricted to New Guinea, and fossils referable to it have been recorded on the Australian mainland (Merrilees 1968) but not in Tasmania.
Specimen: King I.: Holotype (left femur) QVM 1965/39/5.

Dasyuridae

Antechinus minimus (Geoffroy) 1803

Antechinus minimus minimus is found in Tasmania and on the Bass Strait islands, while *A. m. maritimus* is restricted to coastal areas of southern Victoria (Wakefield & Warneke 1963). The species has been recorded from Flinders I. (Green 1969), and Pegarah, King I. (Green & McGarvie 1971). Le Souef (1929) recorded a specimen from Clarke I. and the British Museum holds a specimen from Hummock I. (an early name for Prime Seal I.) (Thomas 1888). Hobbs (1971) records *A. m. maritimus* on Great Glennie Island. Alliston (1966 p. 96) has recorded 'marsupial mice' on Three Hummock Island. Wakefield and Warneke (1963) consider that the type specimen of *A. minimus*, collected by the *Baudin* expedition (Péron & Freycinet 1807: p. 359), came from Waterhouse Island, which lies close to the north-eastern coast of Tasmania. During this study, material referable to this species was found at Ranga Cave, Flinders I., and in the sand dunes of Deal and Preservation Islands.
Specimens: Flinders I.: QVM 1961/1/12, 1967/1/52. King I.: C1925, C1926. Clarke I.: AM M4342. Deal I.: P 28007. Great Glennie I.: C9541.

Sminthopsis leucopus (Gray) 1842

Le Souef (1929) recorded this species from Clarke I. He also obtained a specimen from West Sister I. but incorrectly identified it as *Antechinus flavipes*. Green (1969) notes that the Australian Museum holds a third specimen collected by Le Souef on West Sister Island. Whinray (1972) notes that the species is still present on West Sister and that it has been introduced to East Sister Island. *Sminthopsis leucopus* is possibly more widely spread on the island and some of the small dasyurid material from Ranga Cave may belong to it.
Specimens: Clarke I.: AM M4343. West Sister I.: C9566, AM M4459, M4584, SAM M2879.

Dasyurus viverrinus (Shaw) 1800

Le Souef (1929) stated that 'a Native Cat (*Dasyurus viverrinus*)' was 'reported as still being seen occasionally on Flinders and Barren Islands.' Since there have been no other records of its presence on any of the Bass Strait islands, it is possible that the animals seen on these two islands were in fact the tiger cat, *Dasyurus maculatus*. Campbell (1888) noted that the native cat was apparently absent from King Island. The species has been found in Ranga Cave, Flinders Island, but not in any of the island sand dunes.
Specimens: Ranga Cave, Flinders I.: P27997-9.

Dasyurus maculatus (Kerr) 1792

The tiger cat was recorded on King I. by Campbell (1888), and was last seen there in 1923 according to Courtney (1963). Green and McGarvie (1971) discuss its decline on the island. Gabriel (1894) included it in a list of mammals seen in the Furneaux Group in November 1893, but there are no more recent reports of it from these islands and it may have died out. It is not represented in Ranga Cave, but has been collected from the sand dune deposits of King I., Flinders I. and has also been

collected from a limestone deposit on Cape Barren I. (E. Guiler, pers. comm.).

Spencer and Kershaw (1910a) described a larger species, *Dasyurus bowlingi*, from the sand dunes of King I., from where they also recorded *Dasyurus maculatus*. Marshall and Hope (1973) consider that only the one species is represented. *D. maculatus*, and that the difference in size between the two groups of skulls studied by Spencer and Kershaw is due to sexual dimorphism. Spencer and Kershaw also recorded a large dasyurid jaw from the sand dunes of Deal I., which they suggested might also be referable to *D. bowlingi*. This specimen is now apparently untraceable.

SPECIMENS: Palana, Flinders I.: P28004-5. King I.: C6139; QVM 1940/1/63, 1943/1/50; 1967/1/59; *D. bowlingi*, holotype, P15101, paratypes, P15102, P15111-2, P25940.

Sarcophilus harrisii (Boitard) 1841

The Tasmanian devil has not been recorded alive from any island in Bass Strait. It is represented in the Palana sand dune material by three mandibles which were associated with the remains of species still extant on Flinders Island. Although it has not been found in Ranga Cave, Flinders I., the fragmented condition of the bone there suggests that the Tasmanial devil may have been responsible for part of the deposit.

SPECIMENS: Palana, Flinders I.: P26779-81.

PERAMELIDAE

Isoodon obesulus (Shaw and Nodder) 1797

The brown bandicoot is still extant only on West Sister Island. It was recorded from there by Le Souef (1929) and Whinray (1972) has also commented on the population. Backhouse (1843 p. 85) wrote that he had seen a bandicoot caught by dogs near Blue Rocks, Flinders I., in 1832. This was probably *Isoodon*, as subfossil bones of the species have been recovered from the sand dunes at Palana, Flinders I. Green (1969) noted that J. A. Kershaw mentioned seeing signs of bandicoots on Flinders I. in 1909, but suggested that these diggings had probably been made by echidnas.

There are no records of the species alive elsewhere in Bass Strait, but it has been found as a subfossil on Cape Barren and Passage Islands. It is not represented in Ranga Cave.

SPECIMENS: Palana, Flinders I.: P28006. Cape Barren I.: P28020. Passage I.: P28025. West Sister I.: C7262-68, SAM M2886-91, AM M4451-52. Three Hummock I.: P30899.

Perameles gunnii (Gray) 1838

This species has not been recorded alive from the Bass Strait Islands, but is represented in the Ranga Cave deposit on Flinders Island.

SPECIMEN: Ranga Cave, Flinders I.: P27996.

VOMBATIDAE

Vombatus ursinus (Shaw) 1800

The wombat was first recorded in Australia from Clarke Island in Bass Strait. Flinders (1814 p. cxxxv) recorded: 'Clarke's Island afforded the first specimen of the new animal, called *womat* (sic); but I found it more numerous upon that of Cape Barren; Preservation and the Passage Isles do not possess it'. Spencer and Kershaw (1910b) have described the discovery of the wombat on the islands and given an account of early descriptions of it. It was recorded on King I. in 1802 by Robert Brown (Willis & Skewes 1955), and a plate illustrating two wombats, with four young, with the locality given as 'île King' appears in Lesueur and Petit's Atlas accompanying the account (Péron & Freycinet 1807-16) of the Baudin expedition. The log books of the *Lady Nelson* recorded wombats on Flinders Island in 1802 (Lee 1915 p. 91).

The Field Naturalists' found none on King Island during their visit of 1887 (Campbell 1888), but Spencer and Kershaw (1910a) recorded subfossils from King Island as well as from Deal Island. By 1910 wombats remained only on Flinders Island (Spencer & Kershaw (1910b), where they still persist. McLaren (1966) has described their present distribution on Flinders Island. Robinson (Plomley 1966 p. 270) recorded 'badger' on Woody Island but there are no other records of the species there. Neither is there any record of wombats on Badger Island, though the name suggests that they may have originally been there. During this study subfossils were collected from Flinders, Cape Barren and Deal Islands.

Vombatus ursinus was described on a specimen collected from the Furneaux Group, possibly Clarke Island. The mainland wombat has been described as a distinct species, *V. hirsutus* (Perry) 1810, but Ride (1970) considers all the southeastern Australian wombats to be a single species. Spencer and Kershaw (1910b) separated the Tasmanian population from the island form at a subspecific level, calling the former *V. ursinus tasmaniensis*.

Scott (1915a) suggested that wombat humeri from a cave at Molc Creek, Tasmania, and from Ranga Cave, Flinders I., were attributable to *Phascolomys* (=*Lasiorhinus*) *latifrons*, which occurs in Central Australia. This is probably a misidentification.

SPECIMENS: Flinders I.: C6629-52, C6672-79, C8113, C8333, C10135. King I.: P15103-110. Cape Barren I.: P28024. Deal I.: P28009.

PHASCOLARCTIDAE

Phascolarctos cinereus (Goldfuss) 1817

Alliston (1966 p. 109) commented that four adult koalas had been introduced to Three Hummock Island from Victoria, but that none had been seen again and that it was supposed that they had died.

BURRAMYIDAE

Cercartetus nanus (Desmarest) 1818

The pigmy possum is present on Flinders, King and possibly Cape Barren Islands. Green (1969) recorded that one was found in Launceston inside a bale of wool from Flinders Island, and noted that they are occasionally found in the decaying stumps

of grass trees. The National Museum of Victoria has a female and four young collected at Lady Barron, Flinders I. by J. Whinray in February 1969. Green and McGarvie (1971) noted that the pigmy possum was rare on King Island, but that it is occasionally found at Egg Lagoon. Whinray (1971a) suggested that 'possum mice' reportedly caught on Cape Barren Island in the 1950's were probably *Cercartetus nanus*. It has not been recorded from any fossil deposit on the islands.

SPECIMENS: Launceston (ex Flinders I.?): QVM 1966/1/20. Lady Barron, Flinders I.: C9571. King I.: QVM 1968/1/33, 1968/1/36.

PETAURIDAE

Pseudocheirus peregrinus (Boddaert) 1785

The ringtail possum is still present on Flinders, King and Cape Barren Islands. Gabriel (1894) recorded it for the Furneaux Group, and Le Souef (1929) and Green (1969) recorded it on Flinders Island. Green and McGarvie (1971) noted that it was common about thirty years ago on King Island, but has since declined in numbers there. Whinray (1971a) recorded it on Cape Barren Island. Its remains have been collected from the sand dune deposits of these three islands, and from Ranga Cave, Flinders I.

The Tasmanian population has been regarded as a distinct species, *Pseudocheirus convolutor* Oken 1816 (Tate 1945), and the ringtails of Flinders Island were described as a subspecies, *P. convolutor bassianus* by Le Souef (1929), based mainly on a difference in coloration. Campbell (1888) noted that the ringtails on King Island 'seemed rather darker in colour than the Victorian variety.'

SPECIMENS: Flinders I.: *P. c. bassianus*, holotype, AM M4450, allotype, AM M4449. King I.: C800, C1938, C3940-41. Cape Barren I.: P28021.

PHALANGERIDAE

Trichosurus vulpecula (Kerr) 1792

The brushtail possum is common today on King (Green & McGarvie 1971) and Flinders Islands (Green 1969). It was introduced onto Prime Seal and East Sister Islands in the 1920's and was still present on both these islands in 1966 (Whinray 1971a). Mullett and Murray-Smith (1967) collected a mummified carcase on Erith Island, and recorded sight observations on Dover Island of a brown, furred mammal which they thought was probably a brushtail possum. I collected several specimens on Deal Island in 1966. The brushtail is also present on the islands of the Hunter Group (Guiler 1953), and Alliston (1966 p. 108) has recorded it on Three Hummock Island.

The populations of *T. vulpecula* on the islands are the Tasmanian subspecies *T. v. fuliginosus* Ogilby 1831. Only the grey colour phase is found on King and Flinders Islands (Pearson 1938, Guiler 1953, Green 1969, Green & McGarvie 1971), though the black colour phase, which is dominant in western and southern Tasmania apparently occurs on Hunters Island (Guiler 1953). Le Souef (1929) noted that the possums on Flinders Island were 'similar to, but brighter in colour than, old males from Victoria, differing materially from the Tasmanian form.' Green (1969) noted that old 'reds' seemed to be more common in areas close to the coast on Flinders Island.

Many early records of the brushtail possum on the islands (e.g. Keble (1945), Campbell (1888) for King Island, Gabriel (1894) for Flinders Island, and Le Souef (1891) and Barrett (1944) for Deal Island) identified it as the mountain possum, *T. caninus*, which occurs in wet sclerophyll forest in south-eastern Australia, but not in Tasmania. This possum resembles the Tasmanian form of *vulpecula* in its large size, but is distinguished by its smaller and rounder ear. However, while *T. vulpecula* on the mainland tends to be arboreal in habit, in Tasmania and on the islands it resembles the mountain possum in behaviour, being more terrestrial in habit and feeding to a large extent on the ground. I have seen the possums grazing at night among *Thylogale billardierii* on Flinders Island and among *Macropus rufogriseus* on Deal Island. Wood Jones (1924) noted similar behaviour in *T. vulpecula* on Kangaroo Island, South Australia. In view of this behaviour it is surprising that this species has not been recovered from the sand dune deposits on Flinders or King Islands. It has been found as a subfossil on Passage Island (where it no longer survives), Deal, Erith and Dover Islands, and in Ranga Cave on Flinders Island.

SPECIMENS: Flinders I.: C3771-76, C3833-45. King I.: C8029, C8771. Deal I.: C3831-2, 8048-9, 8051-2, 8055-6, 8731. Erith I.: C9482, P28030. Dover I.: P28016. Passage I.: P28027.

DIPROTODONTIDAE

Diprotodon optatum (Owen) 1838

This extinct species has been recorded from swamp deposits at Egg Lagoon, King Island (Keble 1945). It has not been recorded from Tasmania or elsewhere in Bass Strait.

SPECIMEN: King I.: P14403.

Nototherium sp.

Fossils from the swamp deposits at Egg Lagoon, King Island, were attributed to *N. victoriae* by Scott (1912, 1915a) and those from South-East Lagoon to *N. victoriae* and *N. mitchelli* (Scott & Lord 1921b, c, d, 1924a, b, c). Any genuine specimens of *Nototherium* should probably be referred to *N. inerme* (Woods 1968), but some of this material may in fact be *Zygomaturus trilobus*.

SPECIMEN: King I.: *'N. victoriae'* QVM 1965/39/3, collected by F. H. Stephenson 1912.

Zygomaturus trilobus (Owen) 1859

The type specimen of *Nototherium tasmanicum* Scott 1911, from Mowbray Swamp, northwest Tasmania, has been re-identified as *Zygomaturus trilobus* (M. Plane, pers. comm.), a species which was wide-

spread through southern Australia in the late Pleistocene.

SPECIMEN: Lovell's farm, Mowbray Swamp, Tasmania: *N. tasmanicum*, holotype, QVM 1965/39/2.

MACROPODIDAE

Aepyprymnus rufescens (Gray) 1837

This species has been recovered from Ranga Cave, Flinders Island. A fragmented but almost complete skull was collected in the extension of the cave, and several teeth were found during the excavation of the floor deposit. It is not otherwise known from the modern or fossil faunas of Tasmania and the islands.

SPECIMEN: Ranga Cave, Flinders I.: P 26784.

Potorous apicalis (Gould) 1851

Potoroos are rare but still present on Flinders and King Islands. Le Souef (1929) recorded a specimen from Flinders Island, and in 1966 a decayed carcase was found at Blue Rocks. Several more have since been trapped nearby at Pats River by Mr D. Smith of Whitemark. On King Island they were reasonably common until about 1948, but have since declined in numbers (Courtney 1963). Green and McGarvie (1971) have given some more recent records for this island. Five specimens from Clarke Island were purchased by the National Museum of Victoria in 1923, but apparently none survive on that island now. When I visited Clarke Island in December 1966, the caretaker, Mr T. Higgins, said that he had trapped only rabbits and wallaby there. Whinray (1910a) noted that kangaroo rats were occasionally caught on Cape Barren Island before the Second World War. Atkinson (1890) recorded 'Rat Kangaroo' on Hunter, Robbins, Walker and Three Hummock Islands in the Hunter Group.

Potoroo remains have been recovered as subfossils from King Island (Spencer & Kershaw 1910a) and from Palana, Flinders Island, Cape Barren Island and Deal Island. They are also represented in the subfossil collections from Three Hummock Island held by the National Museum of Victoria.

Courtney (1963) described two specimens from King Island as a new subspecies, *P. tridactylus benormi*. Hope (1969) has studied the taxonomy of these and other populations on the islands, as well as in Tasmania and on the mainland. The King Island population does not differ from that in north-western Tasmania, but these two populations, as well as those from the Furneaux Group and Victoria are smaller than the potoroos from Eastern Tasmania. All, however, are similar morphologically, and distinct from *Potorous tridactylus* of New South Wales.

SPECIMENS: Flinders I. Blue Rocks: C8285; Pats River: C8859; Lady Barron: AM M4398; Ranga Cave: P26786-7; Palana: sand dune: P26782. King I.: C6563-4; SAM M5757-8; *P. t. benormi*, holotype AM M8319, allotype AM M8373. Cape Barren I.: P28017-8. Clarke I.: C6759-60, C6164-6. Deal I. P28008. Three Hummock I.: P30900.

Thylogale billardierii (Desmarest) 1822
Macropus rufogriseus (Desmarest) 1817

These two species are dealt with together, because of the problems of determining which species is meant by literature records of 'wallaby' and 'kangaroo' in Bass Strait. The three large macropods found in Tasmania today, the grey kangaroo, *Macropus giganteus*; the brush wallaby, *Macropus rufogriseus*; and the Tasmanian pademelon, *Thylogale billardierii*, are colloquially referred to there as the forester (or boomer), the kangaroo and the wallaby, respectively. This usage is apparently very old, as G. A. Robinson, in his journals of 1830-35 (Plomley 1966), distinguished between forester kangaroo, bush or brush kangaroo and wallaby kangaroo. It is easy to determine which species is meant when the descriptions are as clear as this, but other writers have often used the word 'kangaroo' without any qualification. In general I have taken 'kangaroo' to refer to *M. rufogriseus*, and 'wallaby' to *T. billardierii* in literature records. Ambiguities often arise, as in Robinson's statement (Plomley 1966 p. 269): '. . . that Hunter Island at one time swarmed with kangaroo: the 11 months he was there he saw 4000 wallaby skins.' Fortunately, there are several reports for most islands, so amgibuous ones need not always be relied on.

The earliest records for the islands are those of Flinders (1801, 1814). He wrote (1801 p. 26): 'Kanguroos (sic) are found upon Preservation, Clarke's and Cape-Barren Islands of the smaller red kind; and the large grey kanguroos have been seen in considerable numbers upon the southern part of the largest island.' The latter island is probably Flinders Island, as Flinders never referred to it by that name, only as the 'large' or 'largest' island (*Ibid.* p. 25). It seems likely that the 'grey kanguroos' were *Macropus rufogriseus* (as there are no other records, except fossil ones, of the great grey kangaroo, *M. giganteus*, on the islands), and that the 'smaller red kind' was *T. billardierii*. However, Flinders later wrote (1814 p. cxxxiv): 'The kanguroo is of a reddish brown, and resembles the smaller species which frequents the brush woods at Port Jackson: when full grown it weighs from forty to fifty pounds. There were no traces of it upon the Passage Isles; but, upon Cape-Barren and Clarkes Islands, the kanguroo was tolerably abundant, though difficult to be procured, owing to the thickness of its retreats. There were also numbers on Preservation Island, when the Sydney Cove was first run on shore; but having been much harrassed and destroyed, a few only were shot during the time of our stay.' The size given is too large for *T. billardierii*, yet the colour is more suggestive of *T. billardierii* than of *M. rufogriseus*. Later, however, on King Island, Flinders commented (1814, p. 207): '. . . and a kanguroo; the last being of a middle size between the small species of the lesser islands, and the large kind found at Kanguroo Island and on the continent. It appeared indeed, all along the South Coast, that the size of the kanguroo bore some proportion to the extent of land which it inhabited.' This certainly suggests that the species

Flinders saw on the smaller islands was *T. billardierii* rather than *M. rufogriseus*. Presumably the 'middle size' kangaroo on King Island was *M. rufogriseus*. Flinders (1814 p. cxlviii) also noted that Swan I. was 'destitute of the kanguroo'.

In the Furneaux Group, 'kangaroo' were recorded on Flinders, Clarke, Badger and Guncarriage (Vansittart) Islands by Scott (1828). G. A. Robinson recorded in 1830 that Clarke Island 'at one time abounded in kangaroo' (Plomley 1966, p. 268), and that Long Island also 'at one time abounded with game.' (*Ibid.* p. 270). Gabriel (1894) included *Halmaturus Bennetti* (=*Macropus rufogriseus*) in a list of mammals noted at the Furneaux Group the previous year. Lord (1908) recorded that 'kangaroo' had died out on Vansittart Island during the 19th century, but had been reintroduced there about 1880 and had become numerous. 'Kangaroo' was also listed for Vansittart Island in Mr John Burgess' records (Ashby 1927), but it is no longer present on that island. Ashby (1927) also listed kangaroo on Flinders, [Cape] Barren and Babel Islands. Whinray (1971a) suggests that the species was introduced onto Babel Island in 1965; and that the present Badger Island population is also an introduced one. As well as these two islands, *Macropus rufogriseus* is still present on Flinders and Cape Barren Islands. In the Furneaux Group, subfossil remains of this species have been found on Flinders, Cape Barren and Preservation Islands, and also in Ranga Cave. A skull of *M. rufogriseus* in the NMV is labelled 'Hummock I., Bass Strait, Jan. '09', and was collected by J. A. Kershaw. Hummock (Prime Seal) Island was visited by Kershaw during the 1909 'New-Year Trip' to the Furneaux Group (Barratt, 1918, Vol. 2: 119-136). The only records of a living macropod on Preservation Island are Flinders' ambiguous comments. It is surprising that *M. rufogriseus* was found in the sand dunes there as this species has been recorded from no other small island. It may, however, have been reintroduced onto Preservation at some time, and have later died out.

Scott (1828) recorded 'wallaby' from the following islands in the Furneaux Group: Flinders, Clarke, Badger, Babel, Prime Seal, Long, Dog, Guncarriage and Little Kangaroo. Robinson recorded that 'wallaby kangaroo' were present on Cape Barren Island in 1831 (Plomley 1966 p. 224). Gabriel (1894) included *Halmaturus billardierii* (= *Thylogale billardierii*) in his list of mammals of the Furneaux Group. Ashby (1927) listed 'wallaby' from Flinders, [Cape] Barren, Clarke, Prime Seal, Babel and East and West Sisters Islands. There are further records of 'wallaby' on Babel (Gabriel 1894), on Badger (Brownrigg 1872) and on West Sister (Barrett 1909). Barrett (1918 Vol. 2 p. 126) commented that wallaby had not been known on Kangaroo Island during the 70 years previous to 1909, and that in 1909 there were 'numerous wallaby' on Hummock (Prime Seal) Island. *Thylogale billardierii* is still present on Flinders, Cape Barren, Clarke and Prime Seal Islands, as well as on East and West Sister (Whinray 1971a). Several from Flinders and Clarke Islands were collected during this study. There is no record of any sort of the species from Mt. Chappell, Tinkettle, Forsyth or Woody Islands, although these are all larger than the smallest island from which species have been recorded. The species has been found subfossil in the sand dunes of Flinders, Cape Barren, Kangaroo and Passage Islands, and in Ranga Cave. Several skulls of *T. billardierii* in the NMV were collected by J. A. Kershaw on Hummock (Prime Seal) I. on 13.1.09.

Flinders (1814, p. cxliv, in footnote) recorded that on the Kent Group 'kanguroos of a small kind were rather numerous'. The log books of the *Lady Nelson* (Lee 1915 p. 96) recorded that in 1801 'two large and 3 small kangaroos' were caught on the Kent Group. Another note (*Ibid.* p. 98) states that three kangaroos were caught on 'the opposite or west side of the land from the cove we lay in.' This suggests that they were caught on Erith Island, as the only cove on that island is on the eastern coast, while the safest anchorage on Deal Island is on the west coast. Grimes (Shillinglaw 1879) also recorded 'a kangaroo' on the Kent Group. Robert Brown spent three weeks on the Kent Group in 1803, and his MS lists several species from there (J. H. Calaby pers. comm.). This reads 'Macropus melanopus Pattemelan Incol: abor: propre P. Jackson vulgaris in Insula orientale. Pondus 16-28 lib;' 'Macropus Bettong Incol. . . . frequens in utraque Insula P. Jackson Pondus 7-12 lib.'; 'Macropus Brush Rat Incol. Aug. P. Jackson umeus visus & occisus in Insula orientali'; 'Didelphis a small animal running on all fours indistinctly seen on the Eastern Island'. The eastern island is Deal, the western ones Erith and Dover.

Table 4 gives some comparative weights for various species on the Bass Strait islands. 'Macropus melanopus' is closest to the samples of *M. rufogriseus* in weight range, 'Macropus Bettong' to *T. billardierii*.

TABLE 4

COMPARATIVE BODY WEIGHTS OF SOME BASS STRAIT AND TASMANIAN MAMMALS

Species	*Mean Kg*	*Range Kg*	*No.*
'Macropus melanopus' Kent Group 1803	—	7·0-13	—
'Macropus Bettong' Kent Group 1803	—	3·0- 5·5	—
Macropus rufogriseus Deal I., May-June 1966	12·4	3·5-21·5	9
Macropus rufogriseus Flinders I. December 1965	12·7	5·0-24·7	9
Thylogale billardierii Flinders I. December 1965	4·6	1·5-10·5	24
Potorous apicalis (from Guiler 1961)	—	0·6- 1·5	—
Potorous apicalis NW. Tasmania 1966-67	0·9	0·8- 0·9	6
Trichosurus vulpecula Deal I., May-June 1966	1·2	0·9- 1·8	5

Both *Potorous apicalis* (subfossil on Deal Island) and *Trichosurus vulpecula* (still extant there) are too small to account for 'Macropus Bettong'. This suggests that both *M. rufogriseus* and *T. billardierii* were on the Kent Group in 1803.

Oxley (1810 p. 775) wrote that in the Kent Group 'the islands are uninhabited, but the Vallies abound with Brush Kangaroo'. In 1831, Robinson noted both wallaby and kangaroo on Deal Island (Plomley 1966 p. 338). However, Stokes (1846, Vol. 2. p. 425) commented that the rabbits he had released there would probably soon overrun the islands, 'there being no wallabies to offer molestation,' and Le Souef (1891) did not mention either species on the islands. Barrett (1918, Vol. 2. p. 122) wrote that in 1909 there were some kangaroo on the island, and noted that he had promised to restock the island with 'wallaby' from 'a Toorak paddock'. I can find no record as to whether this was done. Ashby (1927) listed 'kangaroo' on Deal Island, and *Macropus rufogriseus* were observed and collected there during my visit in 1966. Whinray (1971b) supposed the species to have been introduced to the island.

Apart from Flinders (1814) record for King Island, 'kangaroo' were noted there in 1802 by Robert Brown (Willis & Skewes 1955) and by Grimes (Shillinglaw 1879). The log books of the *Lady Nelson* noted that in 1802 (Lee 1915 p. 120): '15 or 20 kangaroos from 30-40 pounds in weight' were seen on King Island. Stokes (1846 Vol. 1. p. 266) said 'there are three varieties of kangaroo on the island'. Campbell (1888) recorded both species there in 1887, and both are still plentiful (Green & McGarvie 1971). Their remains have been recovered from the sand dunes at Surprise Bay (Spencer & Kershaw 1910a).

Robinson recorded in 1830 that Hunter Island 'at one time abounded with kangaroo, but they are now very scarce' (Plomley 1966 p. 176). It seems that by 1832 *Macropus rufogriseus* was no longer on Hunter Island, as Robinson found it necessary to send sealers to the Welcome River, on the mainland, to procure 'kangaroo' for his party; although the aborigines were still hunting 'wallaby' on the island (*Ibid.* p. 635). Atkinson (1890) recorded only 'wallaby' from Hunter Island, and the most recent record I can find for this island is one of 'wallabies' in 1909 (Barrett 1939).

When Robinson visited Robbins Island in 1830, he wrote: 'It is in the recollection of several persons whom I have conversed with that this island was covered with kangaroo' (Plomley 1966 p. 178). Atkinson (1890) recorded both kangaroo and wallaby. Similarly Robinson recorded that kangaroo had once been common on Walker Island (*Ibid.* p. 178) and Stokes (1846 Vol. 1. p. 273) noted that 'the wives of some sealers' there depended for food on 'wallabi' (sic.). Atkinson (1890) recorded both kangaroo and wallaby here. On Three Hummock Island, in the Hunter Group, 'some small kangaroo' were recorded in 1802, in the log books of the *Lady Nelson* (Lee 1915 p. 124). Robinson recorded in 1830 that kangaroos were rare on Three Hummock, and two years later his Aborigines did not find any 'wallaby' there. However, he wrote that 'Parish informed me that he had been on the island for a long time and caught an abundance of wallaby' (*Ibid.* p. 670). Atkinson (1890) was puzzled by the absence of all mammals here except the rat-kangaroo, but Ashworth and Le Souef (1895) found numerous wallaby bones on the island, and commented that the extinction of the species there must have been very recent. A note associated with a collection of *T. billardierii* from Three Hummock Island, held by the Queen Victoria Museum, Launceston, states that the species was reintroduced onto the island in 1900 by John Burgess, the lessee at that time. This species is still present on Three Hummock Island (Alliston 1966).

Macropus rufogriseus was described on specimens collected on King Island (Iredale & Troughton 1934). The Tasmanian and Flinders Island populations have been described as a separate subspecies, *M. r. frutica* (Ogilby) 1838, and the mainland form as a further subspecies, *M. r. banksiana* (Quoy and Gaimard) 1825. Calaby (1971) considers the Tasmanian and island populations to be a distinct subspecies from that on the mainland. No subspecies of *Thylogale billardierii* have been described, but the populations on the various islands vary considerably in tooth and skull size.

SPECIMENS: *Thylogale billardierii*: Flinders I.: C6013-35, C7998-8005. King I.: C7906-07, P24515-34, P24552-6. Cape Barren I.: P28022-23. Prime Seal I. : C6000-12, C6966-68, P24510-14. West Sister I.: C7838-47, C7996-98, C8062-74. East Sister I.: AM M4782-3. Clarke I.: C8006, 8010, 8025. Passage I.: P28028. Deal I.: P28012. Erith I.: P28039. Kangaroo I.: P24535-6. Three Hummock I.: QVM 1961/1/29; P30901-2.
Macropus rufogriseus: Flinders I.: C6537-52, C8034-41. King I.: C1939-44, C7905, C8033. Cape Barren I.: C7852-3, C8835-43. Preservation I.: P28015. Deal I.: C8042-47, 8053-4, 9191-2. Erith I.: P28031, P30903.

Macropus giganteus (Shaw) 1790

The grey kangaroo has not been recorded alive from the islands of Bass Strait, but was recorded as a subfossil from Deal Island by Le Souef (1891). This specimen is now untraceable. Several teeth referable to *M. giganteus* have been recovered from Ranga Cave, Flinders I.

SPECIMEN: Flinders I. Ranga Cave.: P27995.

Protemnodon anak (Owen) 1859

This species has been recorded, as '*Macropus anak*', fossil on King Island, from both the swamp deposits at South-East Lagoon (Scott & Lord 1924c) and from calcarenites at Surprise Bay (Scott 1905). This material was not examined during this study. The NMV holds specimens of skull and mandible fragments of this species, which are probably part of the collection reported by Keble (1945).

SPECIMEN: King I.: P30786.

Sthenurus occidentalis (Glauert) 1910

Several fossil specimens collected from the calcarenites at Surprise Bay, King Island, were identified first as *Procoptodon rapha* (Scott 1906) and later as *Sthenurus atlas* (Scott 1917). These are in fact referable to *Sthenurus* (*Simosthenurus*) *occidentalis* (Anderson 1932; Telford 1966).

SPECIMENS: King I.: QMV 1971/39/1 (skull), 1971/39/2 (right mandible), 1971/39/3 (premolar and molar removed from skull).

MURIDAE

Hydromys chrysogaster (Geoffroy) 1804

This species was recorded from Flinders Island by Le Souef (1929) and is still present there (Green 1969; Whinray 1971a). Whinray (1971a) noted that the water rat was most recently seen on West Sister I. about 1960, was noted on Prime Seal Island during the 1920's and 1930's and has been seen recently on Cat Island. The South Australian Museum has a specimen collected on West Sister Island in 1929 or 1930. The species is also recorded for Three Hummock Island (Alliston 1966, p. 97). The water rat is probably present on many of the islands with permanent rivers or creeks.

SPECIMENS: Flinders I.: C4847. West Sister I.: SAM M2892.

Rattus fuscipes (Waterhouse) 1839

The bush rat has been recorded in Bass Strait only from Great Glennie Island off Wilsons Promontory. Hobbs (1971) has studied the population there, which is slightly larger in skull size than populations of the species in Victoria.

SPECIMEN: Great Glennie I.: C9068.

Rattus lutreolus (Gray) 1841

The swamp rat has been collected alive on Flinders, King, Cape Barren and Hogan Islands. It has been recorded as a sub-fossil from the sand dunes of Flinders, Cape Barren, Passage, Preservation, Deal and Erith Islands, and from Long Island in the Hogan Group. It may be still extant on some of these islands and on others as well.

'Rats', 'bush rats' or '*Mus* sp.' were recorded from many islands by early visitors to Bass Strait (e.g. Campbell 1888; Gabriel 1894). It is difficult in most cases to determine which species is meant. G. A. Robinson recorded 'rats' on Deal, Clarke, Woody and Swan Islands in 1830-35, and commented on their numbers and habits on Swan I. (Plomley 1966, p. 353): 'Nor should I omit to mention the numerous rats which infest this and all other islands, as these destructive animals make regular nocturnal visits to the stores and to every part of the encampment'.

The evidence for *R. lutreolus* invading human habitation is indefinite; Green (1967) quoted a report of this species invading camps of duck-shooters, but on the other hand he found that it rarely invaded walking huts in Tasmania. It is possible that the rats that plagued Robinson were *R. rattus* since there were already several hundred sealers living on the islands by 1830. Yet *R. rattus* is now found on very few islands in the Strait.

On Flinders Island *R. lutreolus* was trapped in a dense stand of *Melaleuca squarrosa* in Smith's Gully in 1966-7. Green (1969) has also collected it at Memana and Locotta. On King Island the species was taken amongst *Melaleuca ericifolia* and *Acacia melanoxylon* at the Nook, a swampy interdune area on the NE. coast. Green and MacGarvie (1971) also record several specimens from King Island. Whinray (1971a) has collected a specimen on Mt Munro, Cape Barren Island. On Hogan Island, several specimens were trapped in January 1968, amongst outcrops of calcarenite about 5 m from the shore. Here the vegetation consisted of an open shoreline community of low herbs and grasses on loose calcareous sands.

Green (1969) and Green and McGarvie (1971) noted that the specimens they collected on King and Flinders Island belonged to the Tasmanian subspecies, *R. lutreolus velutinus* (Thomas) 1882. The specimens from Hogan Island also belong to this subspecies (Wakefield 1969).

SPECIMENS: Flinders I., Smiths Gully: C8324, C9465, Memana: QVM 1967/1/39-40. King I. The Nook: C8320, C8328. Locotta: QVM 1967/1/53, 1967/1/55. Cape Barren I. Mt. Munro: C9635, Cape Barren sand dune: P28019. Deal I.: P28010. Erith I.: P28011. Preservation I.: P28013. Passage I.: P28026. Hogan I.: C8325-27, C8814-17, C8846. Long I. (Hogan Gp.): P28014.

Rattus rattus (Linnaeus) 1758

On Flinders Island the introduced ship rat was trapped at Smith Gully in December 1966-January 1967 in the same tea-tree swamp as *R. lutreolus*. It was also trapped at Palana. Green (1969) also collected the species at Smiths Gully and at Lackrana. The rat is abundant throughout the muttonbird rookery on Big Green Island (Norman 1966), and Whinray (1971a) has trapped it at Mt Munro, Cape Barren Island. He also records one found dead in a mutton-birding shed on Great Dog Island in 1967. I trapped several on Deal Island in May-June 1966. Green and McGarvie (1971) record three collected at Pegarah, King Island.

SPECIMENS: Flinders I.: C8695-6, QVM 1966/1/15, 1967/1/41. King I. Pegarah: QVM 1968/1/8-10. Big Green I.: C7764-65.

Mus musculus (Linnaeus) 1758

The introduced house mouse is common on both Flinders Island (Green 1969) and King Island (Green & McGarvie 1971). Campbell (1888) reported that 'imported mice' were very numerous on King Island in 1887. Whinray (1971a) has recorded the species from Flinders, Cape Barren, Babel, East Kangaroo, Great Dog, Little Dog, Badger and East Sister Islands. He notes that it was present on Prime Seal Island in the 1920's and 1930's.

SPECIMENS: Babel I.: C7791-93.

Pseudomys novaehollandiae (Waterhouse) 1843

Several skull fragments and lower jaws recovered

from Ranga Cave on Flinders Island may be referable to this species. The only record of the New Holland mouse in Tasmania is from a cave deposit at Flowery Gully (Green 1967; Gill 1969).

Pseudomys higginsi (Trouessart) 1899

The long-tailed rat has not been recorded alive from any of the Bass Strait islands, but it has been found in the sand dune deposits on King Island and in Ranga Cave, Flinders I.

The species is endemic to Tasmania, but has recently been found as a fossil in cave deposits in Victoria and New South Wales (Wakefield 1972).

SPECIMENS: King I.: P28001. Ranga Cave, Flinders I.: P30898.

Mastacomys fuscus (Thomas) 1882

This species has been recovered from the bone deposit at Ranga Cave, Flinders Island. Calaby and Wimbush (1964) give the locality of a specimen collected by Brazenor (1934) as Swan Island, Bass Strait. However, this specimen (C200) is in fact from the Swan Island in Port Phillip Bay, since the museum label gives its locality as 'Swan I. nr Queenscliffe'. There are apparently no other records of *M. fuscus* from Bass Strait.

SPECIMEN: Ranga Cave, Flinders I.: P28000.

PTEROPODIDAE

Pteropus poliocephalus (Temminck) 1825

A grey-headed fruit bat was found in a shed on Babel Island in 1955 (Sharland 1962) and a further specimen was captured on Great Dog Island in 1958 (Green 1969). Green and McGarvie (1971) recorded two similar occurrences on King Island.

VESPERTILIONIDAE

Nyctophilus geoffroyi (Leach) 1821

The lesser long-eared bat has been reported from both King and Flinders Islands (Green 1966) and one has also been collected in an old house on West Sister Island (Green 1969).

SPECIMENS: Flinders I. Whitemark: QVM 1968/1/19. King I.: QVM 1968/1/50. West Sister I.: QVM 1968/1/28.

Eptesicus pumilus (Gray) 1841

One specimen of the little brown bat was collected at Emita, Flinders Island in 1947 (Green 1969).

SPECIMEN: Flinders I.: QVM 1959/1/4.

FELIDAE

Felis catus (Linnaeus) 1785

Feral cats are present on Flinders Island (Green 1969) and King Island (Green & McGarvie 1971). Whinray (1971a) recorded them for Cape Barren, Clarke, Babel, East Sister, Little Green, Great Dog, Little Dog and Mt Chappell Islands, and reports that they were very common on Prime Seal Island in the 1920's and 1930's. They were noted on Deal Island in 1890 (Le Souef 1891) and on King Island in 1887 (Campbell 1888). Barrett (1918 Vol. 2 p. 138) noted 'imported cats' on Ninth Island in 1909. Alliston (1966 p. 109) has recorded wild cats on Three Hummock Island.

CANIDAE

Canis familiaris (Linnaeus) 1785

Although there are no reports of feral dogs still present on most of the islands, it is clear from early reports that they were common there during the last century. The dogs originally belonged to the Aboriginal women living with the sealers and were used to hunt kangaroo and wallaby, but inevitably many went wild. G. A. Robinson commented on the number of dogs on the islands between 1830 and 1835. He wrote that on Guncarriage Island (Plomley 1966 p. 272): 'It was a singular sight to see the women return from the bird rookery with their numerous dogs, most of them of a very large kind. I counted upwards of forty and was told that there was fifty dogs then on this island and at Woody there was ten, besides the herd of dogs the women have taken with them to Flinders. I suppose there cannot be less than two hundred dogs in these straits, all of a very large description. Most of these islands are infested with wild dogs'. Robinson also recorded wild dogs on Great Dog and Little Dog Islands, and on Swan Island 'thirty large and fierce dogs belonging to the natives' (*Ibid*: 374). In 1908 Lord reported that there were less wild dogs on Flinders at that time than for many years. Alliston (1966 p. 109) suggests that feral dogs may still be present on Three Hummock Island.

LEPORIDAE

Oryctolagus cuniculus (Linnaeus) 1785

Rabbits are common on Clarke Island, where they were introduced about 1923, according to Whinray (1971a). Stokes (1846. Vol. 2 p. 424) released about a dozen rabbits on Deal Island in 1842. Le Souef (1891) commented that in November 1890, rabbits were numerous on Erith Island, where there were no 'half wild domestic cats to destroy them like there are on Deal Island'. J. A. Kershaw recorded rabbits on Erith Island in 1909 (Green 1969), but there are no more recent records of them there, though skulls have been collected from a sand blow on that island. In 1966 the lightkeeper told me that rabbits were still occasionally seen on Deal Island.

Stokes (*Ibid.* p. 426) also commented that a sealer had released a pair of rabbits on Rabbit Island about six years before his visit in 1842; by then they were abundant. Barrett (1918, Vol. 2 p. 115, 121) recorded that they were still on Rabbit Island, but Norman (1971) says that they seem to have been eliminated by myxomatosis and '1080' poisoning.

Rabbits were recorded on Big Green Island by Thomas (1861), but H.S. (1883) wrote that: 'In five years eight thousand rabbits . . . were killed, but now there is not a rabbit to be seen'. There are no rabbits on Big Green now. Rabbit bones have been collected from a sand blow on nearby Kangaroo Island. There seem to be no rabbits on Flinders Island at present, and Green (1969) has described the

attempts made to eradicate the few that have been seen there over the last 20 years.

There are no records of rabbits on King Island or the Hunter Group.

Lepus europaeus (Pallas) 1778

The introduced hare is present only on West Sister Island. They were recorded there by Barrett (1909), and have apparently been there for at least 60 years (Whinray 1972).

BOVIDAE

Cattle, Sheep and Goats

The smaller islands especially have had a long history of grazing, and many are still leased for this purpose. Apart from domestic sheep and cattle, goats were released onto many islands during the last century. Le Souef (1891) recorded that one was present on Erith Island in 1890, and Barrett (1909) recorded them on West Sister Island. They were liberated on Seal Island off Wilsons Promontory in 1884 to provide emergency food for the light keepers on nearby Cliffy Island (Victorian Department of Public Works 1970). Bones of cattle and sheep or goats have been found in the sand dunes of many islands.

SUIDAE

Sus scrofa (Linnacus) 1785

Wild pigs are fairly common on Flinders Island, particularly in the Strzelecki Ranges. They were observed in Smiths Gully in December 1965 and December 1966. Pullar (1953), in a study of feral pigs in Australia, suggested that those on Flinders Island were derived from domestic pigs placed on the island by sealers to breed at will and augment the food supply. Stokes (1846, Vol 2, p. 445) noted that pigs had been liberated on to Swan Island.

THE DEVELOPMENT OF THE MAMMALIAN FAUNA OF THE ISLANDS

Using the fossil record of the islands and the modern historical reports, the mammalian fauna on the Bassian land bridge at the end of the Pleistocene can be reconstructed, and its development traced through its subsequent isolation on the islands, until the present day.

In the Late Pleistocene there was, at least on the western side of the Bassian peninsula, a mammal fauna, containing both extinct and modern species, similar to that present over wide areas of Australia at the time. Only one of the extinct Pleistocene species (*Zaglossus harrissoni*) may have been restricted to this region; the remainder were common species throughout southern Australia. However, all of the modern species associated with the Pleistocene ones are Tasmanian. It is not known how long the extinct species survived on the peninsula, but they are not found in any of the Aboriginal middens in Tasmania which date back to 8,500 years BP (Jones 1968) nor at Flowery Gully Cave (Gill 1968) or Ranga Cave which are both about the same age. The calcarenites on King Island containing *Sthenurus occidentalis* and *Protemnodon anak* are undated but probably consolidated during the last glacial period. On the mainland the extinct marsupials do not seem to have survived later than the end of the last glaciation.

Merrilees (1968) and Jones (1968) have discussed the Australia-wide extinction of the giant species of the Pleistocene fauna and suggest that their disappearance was due to environmental modifications due to man-made fires, rather than to climatic change as has often been suggested. There is certainly evidence that the Tasmanian vegetation has been modified by fires set by Aboriginal man (Jackson 1965), but these fires usually resulted in increasing areas of grassland and sedgeland, which would perhaps have been more congenial than the natural climax forest to the extinct species. An increase in aridity, which has been suggested as a cause for the extinction of the Pleistocene fauna, would in Tasmania have had a similar effect in providing more open country.

Although it is generally believed that Aboriginal man reached Tasmania by way of the Pleistocene land bridge (Jones 1968), the major islands of Bass Strait were found to be completely uninhabited by man when Europeans first visited them. Only the islands of the Hunter Group, close to the Tasmanian coast, were inhabited, or at least regularly visited by the Tasmanian Aborigines (Meston 1936). Jones (1968) has suggested that during late glacial times the economy of the Tasmanian Aborigines was exclusively marine, so any archaeological sites of this time would have been strictly coastal and would have been drowned postglacially by rising sea level. However if Aborigines were living even along the coasts of the glacial Bassian peninsula, they may have had some influence on the mammalian fauna.

Whatever the reasons, the Pleistocene species had probably disappeared by the end of the glaciation, and the fauna of the land bridge at the time it began to break up was that of Tasmania today, with the addition of two species, *Aepyprymnus rufescens* and *Pseudomys novaehollandiae*. Between the time the islands finally took shape at about 8,000 years ago, and the arrival of European explorers at the end of the 18th century, several Tasmanian species, mainly those that have been recorded only from Ranga Cave, had disappeared completely from the islands. These were probably affected by the reduc-

tion or disappearance of their habitat on the islands, due either to a reduction in size of the islands, to climatic change or to a combination of both factors. Wetter habitats were certainly more extensive on King Island in the past, as elements of the Tasmanian rainforest grew there about 37,500 years ago (Jennings 1959, 1961).

Among the mammal species that disappeared during this time are the rodents *Mastacomys fuscus* and *Pseudomys higginsi*. *Mastacomys fuscus* is found today in tussock sedgeland and *P. higginsi* in rainforest areas in Tasmania (Green 1968) and both these species probably died out on the islands because of the reduction of their habitats. The brown bandicoot, *Perameles gunnii*, also died out on the islands at an early date as it has been recorded only at Ranga Cave, while the short-nosed bandicoot, *Isoodon obesulus*, is still present in open grassland on West Sister Island in the Furneaux Group. The latter has also been found among the sand dune fossils from Flinders and Cape Barren Islands, and although it is no longer extant on these islands, it was recorded alive on Flinders Island in 1832. It is difficult to understand why *Perameles* should disappear and *Isoodon* survive since Heinsohn (1966) found that the latter prefers dense vegetation in Tasmania, while *Perameles* is commonly found in open grassland. A similar situation occurs in the distribution of the two rat-kangaroos in Tasmania and the islands. The eastern bettong, *Bettongia gaimardi*, which in Tasmania inhabits the drier and more open sclerophyll forests, has never been recorded from the islands, while the southern potoroo, *Potorous apicalis*, which prefers densely vegetated areas, still occurs on Flinders and King Islands. Again, the eastern native cat, or quoll, *Dasyurus viverrinus*, recorded on the islands only at Ranga Cave, is found in dry sclerophyll-heathland habitats in Tasmania, while the tiger cat, *Dasyurus maculatus*, which may be still extant on the larger islands, prefers wetter habitats. However, it is likely that many of the islands were covered with thick shrubland until cleared within the last 170 years (Guiler 1967), and King Island, at least, was partly vegetated with wet sclerophyll forest. The three species *I. obesulus*, *P. apicalis* and *D. maculatus* have certainly suffered more than the other larger mammals on the islands from modern land development and clearing.

Two species in the Ranga Cave deposit, *Aepyprymnus rufescens* and *Pseudomys novaehollandiae*, have not been recorded alive in Tasmania or on the islands. On the mainland, both species are well represented on fossil deposits in Victoria and New South Wales (Wakefield 1964, 1967a; Mahoney & Marlow (1968), but their present distribution is very restricted. *Aepyprymnus rufescens* is found only in coastal regions of northern New South Wales and southern Queensland (Marlow 1957) and *P. novaehollandiae* survives in small colonies on the central coast of New South Wales and on the Mornington Peninsula in Victoria (Seebeck & Beste 1970). Since the restriction of their range is not confined to Tasmania and the islands of Bass Strait it is probably unrelated to factors operating only in this latter area.

There are only two island populations of species that are not also present in Tasmania, and which do not have a fossil history in the area. These are the populations of *Rattus fuscipes* and *Antechinus minimus maritimus* on Great Glennie Island. This island is only about 6 km from Wilsons Promontory, so the two species may be recent immigrants from the mainland. It is not surprising that there are no more immigrant populations on the islands of Bass Strait, since the predominant ocean currents in the strait are strongly westerly (with a tendency to southwesterly) and easterly (Wyrtki 1960). Macintosh (1949), in a study of possible Aboriginal migration routes across Bass Strait, concluded that there was little likelihood of a raft being carried from Victoria to the larger islands of Bass Strait or to Tasmania, although it would be possible for one from western Tasmania to reach Victoria or the eastern islands of the Strait. His results are equally applicable to animal rafting.

Table 5 gives the distribution of the herbivorous marsupials in Tasmania, King Island and on the islands of the Furneaux and Kent Groups at the time of European settlement (taken at 1800) and at present (taken as 1967, the time of this study). Smaller marsupials and rodents have been excluded because of the lack of information about their distributions; no mammals have been recorded from the many islands of less than 0·9 sq km in area. Erith and Dover Islands in the Kent Group are listed as one island, since they are linked by a rocky swashway and have probably been effectively one island in the past.

Faunal records from the Hunter Group are also omitted from the Table, as they were certainly visited by Aborigines from Tasmania in pre-contact times (Meston 1936) and their fauna may have been affected by Aboriginal hunting and burning. Robbins Island, the largest of the group, is about the same size as Clarke Island, and Hunter and Three Hummock Islands are a little

TABLE 5

DISTRIBUTION OF HERBIVOROUS MARSUPIALS IN TASMANIA AND ON THE ISLANDS OF BASS STRAIT, 1800-1967

ISLAND	AREA sq km	SPECIES - 1800										SPECIES - 1967									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
TASMANIA	67,900	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
FLINDERS	1,330		+	+	+		+	+	+	+			+	+	+		+	+	+		
KING	1,100		+	+	+		+	+	+				+	+	+			+	+		
CAPE BARREN	445		+	+	+		+		+	+			+	+					+		
CLARKE	115		+	+	+		+							+							
DEAL	20		+	+	+?		+?	+						+				+			
BADGER	10		+	+									(+)								
PRIME SEAL	8.9		+?	+										+				(+)			
VANSITTART	8.1		+	+																	
ERITH-DOVER	7.8		+?	+				+										+			
WEST SISTER	6.1			+						+				+						+	
BABEL	4.4			+									(+)								
EAST SISTER	4.0			+										+				(+)			
MT. CHAPPELL	3.6																				
GREAT DOG	3.3			+																	
PRESERVATION	3.0		+																		
LONG	3.0			+																	
PASSAGE	2.4			+?				+?		+?											
FORSYTH	1.9																				
TINKETTLE	1.7																				
WOODY	1.6						+														
KANGAROO	1.4			+																	
GOOSE	0.9																				
GREEN	0.9																				
LITTLE DOG	0.8																				
LITTLE GREEN	0.8																				

KEY

1. *Macropus giganteus*
2. *Macropus rufogriseus*
3. *Thylogale billardierii*
4. *Potorous apicalis*
5. *Bettongia gaimardi*
6. *Vombatus ursinus*
7. *Trichosurus vulpecula*
8. *Pseudocheirus peregrinus*
9. *Isoodon obesulus*
10. *Perameles gunnii*

? Possibly extinct before 1800; recorded only as subfossil

( ) Introduced.

smaller. Walker Island is actually the northern part of Robbins Island and the channel between the two dries. It seems likely that *Macropus rufogriseus, Thylogale billardierii, Potorous apicalis* and *Trichosurus vulpecula* were originally on Robbins and Hunter, *M. rufogriseus, T. billardierii* and *P. apicalis* on Walker, and *T. billardierii, T. vulpecula* and *I. obesulus* on Three Hummock.

Many of the herbivorous species survived until 1800 only on the larger islands, and the smaller

ones before this time carried only one or two species, the most persistent being *Thylogale billardierii*. The minimum area for the support of one herbivorous marsupial species in Bass Strait before 1800 seems to have been 1·4 sq km (about 0·5 sq. miles). Apart from Passage Island, where the three species have been recorded only as fossils and so may have died out well before 1800, the smallest area to support two or more species seems to have been 6·1 sq km (about 2·3 sq miles). Main (1961) found similar area/species ratios for macropod species on islands off Western Australia, where the smallest island supporting one species is 0·4 sq miles (about 1·0 sq km). Eleven islands between 0·4 and 6·0 sq miles (15·5 sq km) support one species, and four islands between 18 (46·5 sq km) and 240 (622 sq km) sq miles each support three species. There are no islands in the size range 6-18 sq miles (15·5-46·5 sq km) off Western Australia. In Bass Strait there are no records of marsupials from Green and Goose Islands in the Furneaux Group, both of which are 0·9 sq km (0·4 sq miles), the same size as the smallest of the Western Australian islands. This may be due to the presence of the Cape Barren Goose, *Cereopsis novaehollandiae*, which is a herbivore and presumably a competitor to the marsupials. Badger, Mt. Chappell and Goose Islands in the Furneaux Group are its main breeding islands, but Green Island also maintains a high population of geese (Guiler 1967). No marsupial species have been recorded from Mt Chappell Island either, though it is larger than several which are known to have supported *T. billardierii*. Here it is more likely that competition for the limited resources of the smaller islands determined how many species survived on each.

After 1800 the mammals on the smaller islands disappeared quickly because of hunting pressure. Early reports indicate that on some islands, such as Preservation, the larger marsupial species were wiped out in only a few years. The faunas of the larger islands have survived rather better. The wombat, *Vombatus ursinus*, and also an emu, *Dromaius ater*, disappeared from King Island in the 19th century. The wombat has also gone from Cape Barren and Clarke Islands, and Clarke Island has also lost *M. rufogriseus*. Flinders Island seems to have lost only *Isoodon obesulus*. The Tasmanian devil, *Sarcophilus harrisii*, may not have died out in Flinders Island until after 1800 as it is the only species recovered from the sand dunes there that is not otherwise recorded from the island since that time. It may have been overlooked by the early explorers, as Flinders Island was not inhabited or generally visited until the 1830's. The large scale alterations in habitat due to the extensive clearing and land settlement on King and Flinders Islands and the continual burning of almost all the islands may not have had their full effect yet. These factors, however, are probably responsible for the decline of *Potorous apicalis* and *Dasyurus maculatus* on the larger islands and these species probably have little chance of survival.

DISTRIBUTION PATTERNS IN BASS STRAIT

The island faunas of Bass Strait display two main distribution patterns that must have originated on the Pleistocene land bridge connecting Tasmania to the mainland. The first of these is the difference in faunal composition between the eastern and western islands. The second, and more important, is the disjunction between the mainland fauna to the north of Bass Strait and the Tasmanian fauna on the islands to the south. In both cases the pattern is found in other vertebrates as well as in the mammalian fauna.

The Difference Between The Eastern and Western Faunas

Littlejohn and Martin (1965) found that of the ten species of frogs in Tasmania, four are widespread in Australia and two endemic species are restricted to Tasmania itself and not found on any island. Of the remainder, two species are common to Tasmania, King Island and Victoria. They concluded that the difference in distribution between King Island and Flinders Island indicated that the western side of the Pleistocene land bridge was wetter than the eastern side. Rawlinson (1967) found a similar distinction between the reptile faunas of King and Flinders Islands. The latter has three species shared with Tasmania which are absent from King Island. These three species probably had a very restricted distribution during the Pleistocene, while those species common to Tasmania and both King and Flinders Islands have a wide range on the mainland. Rawlinson suggested that the eastern side of the land bridge was more suitable as a corridor for reptiles, probably due to its greater ecological diversity, while only the more tolerant reptile species were able to use the western side.

There are also some differences between the avifaunas of eastern and western Bass Strait. On King Island the mainland influence is more pronounced, as several bird species reach the southern limit of their range there, while only one non-

Tasmanian species has been recorded from the Furneaux Islands (Green & McGarvie 1971). The King Island emu, *Dromaius ater*, which like the wombat, became extinct there during the last century was apparently absent from the eastern islands. The emu was smaller and stockier, with shorter legs than any of the other emu species, and Green and McGarvie have suggested that it may have adapted to the denser vegetation on King Island in a way parallel to the cassowary of the tropical rainforests.

While most of the mammal species recorded from Bass Strait are widespread there and in Tasmania, a few appear to follow the pattern displayed by the amphibians and reptiles. The grey kangaroo, *Macropus giganteus*, is now restricted in northeastern Tasmania, and historical records such as those of G. A. Robinson for the 1830's (Plomley 1966) suggest that at the time of European settlement it inhabited the open savannah country of eastern Tasmania, and was absent from western Tasmania. In Bass Strait fossil remains of this species have been found only in the eastern chain of islands, at Ranga Cave on Flinders Island and in the sand dunes of Deal Island, in the Kent Group (Le Souef 1891). However, *M. titan* has been recorded as a fossil from Scotchtown Cave, in northwestern Tasmania (Gill & Banks 1956), and this species may be merely a larger Pleistocene variety of the modern grey kangaroo (L. G. Marshall, pers. comm.). Several other species which prefer open country, the eastern native cat, *Dasyurus viverrinus*, and the barred bandicoot, *Perameles gunnii*, have also been recorded only from Flinders Island. This may be just due to collecting bias as those species are known only from the fossil deposit at Ranga Cave, and no equivalent deposit has yet been found from King Island. Similarly the lack of records of the extinct Pleistocene species from the Furneaux Group and eastern Tasmania is probably due to the fact that no suitable deposits have yet been investigated there.

The southern potoroo, *Potorous apicalis*, shows a cline in size and colour from east to west across northern Tasmania, potoroos from the northwest being small and rufous-brown, while those from the east are large and grey-brown (Hope 1969). The modern population of potoroos on King Island is indistinguishable from those in northwestern Tasmania. In eastern Bass Strait, the modern populations on Flinders and Clarke Islands are small and grey-brown. The remains of small potoroos have also been recovered from the sand dunes on Deal and Cape Barren Islands. Fossils of *P. apicalis* from Ranga Cave are much larger than the modern potoroos from Flinders Island and approach the modern eastern Tasmanian ones in size. It seems that the present cline across Tasmania was already in existence on the land bridge before the islands were isolated postglacially. The potoroos on the eastern islands have diminished in size since then, so that their similarity in size to the modern potoroos on King Island and in western Tasmania may be due to convergence.

These differences between east and west correlate very well with the present precipitation gradient across Tasmania. Those that occur on the islands must date back to the time that the land bridge was in existence, suggesting that the precipitation gradient must have been as strong across the Bassian peninsula in the Pleistocene as it is across Tasmania today.

The Disjunction Between The Northern and Southern Faunas

The vertebrate fauna of the Bass Strait islands is basically that of Tasmania, so that the disjunction between the southern Tasmanian and the northern mainland faunas occurs at the northern extreme of Bass Strait, close to the Victorian coastline. In particular, most of the species and subspecies endemic to Tasmania are present on the islands as well as in Tasmania. The main exception to this is in the amphibia, where the two endemic frog species are restricted to Tasmania itself. However, two of the four endemic reptile species occur on Flinders Island as well as in Tasmania (Rawlinson 1967) and one occurs on King Island (Green & McGarvie 1971). Of the 14 endemic Tasmanian bird species, 11 have been recorded from King Island and 8 from Flinders Island (Ridpath & Moreau 1966, Green 1969 and Green & McGarvie 1971). Undoubtedly some of the endemic Tasmanian bird species are in fact relict species which once had a wider distribution, as Ridpath and Moreau have suggested.

Since mammals have a reasonable fossil record in Australia, it is possible to eliminate from the list of endemic species those which are now extinct on the mainland and are relict species in Tasmania. In fact, all three of the mammals species that are now endemic to Tasmania, *Thylacinus cynocephalus*, *Sarcophilus harrisii*, and *Pseudomys higginsi*, have been recorded as fossils on the mainland. The first two had extensive distributions throughout Australia during the Pleistocene, and the thylacine also reached New Guinea. There is nothing to suggest that either species originated in Tasmania. The remaining species, *P. higginsi*, has recently been recorded in

fossil deposits at Buchan, Victoria, and Wombeyan Caves, N.S.W. (Wakefield 1972). Wakefield has described these fossil populations as a subspecies distinct from the modern Tasmanian one.

The Tasmanian populations of several mammals are also regarded as subspecifically distinct. These are *Tachyglossus aculeatus setosus, Antechinus swainsonii swainsonii, A. minimus minimus, Pseudocheirus peregrinus convolutor, Trichosurus vulpecula fuliginosus, Bettongia gaimardi cuniculus, Macropus rufogriseus rufogriseus* (on King Island only) and *M. r. frutica* (Tasmania and Flinders Island) and *Rattus lutreolus velutinus.* Many of these have often been considered to be full species. All are present on the islands of Bass Strait except *B. g. cuniculus* and *A. s. swainsonii,* which have never been recorded there alive or fossil.

The presence of the endemic Tasmanian subspecies on the islands of Bass Strait suggests that their differentiation must predate the last 8-10,000 years that the islands have been isolated from Tasmania. It is likely that speciation occurred in Tasmania when that island was isolated from the mainland during an interstadial or interglacial. The initial presence of the Tasmanian species and subspecies rather than the mainland ones on the land bridge that subsequently developed during the low sea level glacial period would be ensured by the topography of Bass Strait, the deepest water of which is at the N. The Tasmanian species would thus have an advantage over the mainland species and would be more likely to be isolated on the islands formed at the end of the glaciation.

The sequence of formation of a land bridge across Bass Strait is the reverse of that described by Jennings (1971) for its postglacial flooding. As sea level fell, the islands of the Furneaux Group would coalesce, and then be joined to northeastern Tasmania. Later King Island would be connected with northwestern Tasmania, and then the Furneaux Group would join Wilsons Promontory, Victoria. Finally the central area of Bass Strait would become dry land and a connection form between King Island and Cape Otway. By the time the final water barrier disappeared between the mainland and the greatly enlarged island of Tasmania, the Tasmanian fauna would have had ample time, perhaps several thousand years, to move N. onto the developing land bridge, driven perhaps by the deterioration of climate in central Tasmania, and to become established there before coming into contact with the mainland fauna. The first line of contact between the southern fauna and the northern, mainland one would have been somewhere N. of the Hogan Group within 30 km of the present Victorian coastline. In short, the Tasmanian species would be moving N. onto uninhabited, newly exposed land as the sea level fell, but mainland species attempting to move S. would be met with the Tasmanian fauna already established on the land bridge.

When the southern and the northern faunas met, at a line somewhere S. of the Victorian coastline, several things may have happened. If a population isolated in Tasmania had differentiated sufficiently so that it was no longer capable of interbreeding with its mainland relative, then when the two met at the N. of the land bridge, the boundary between the species could have stabilized at the point of contact, with neither species able to displace the other. In such a case the Tasmanian species would be the one found on the islands when the land bridge broke up at the end of the glaciation. However most of the mammals that fall into this category (that is, where the island populations are the Tasmanian endemic form rather than the closely related mainland one) are generally regarded only as subspecies. If they are merely subspecies, then some interbreeding should have occurred between the mainland and Tasmanian forms on the land bridge, so that the present island populations would be intermediate between the two. This may be the case with some birds. Populations of *Acanthiza* and *Sericornis* on the Kent Group have generally been considered to be the Tasmanian endemic species, *A. ewingi* and *S. humilus* (Ridpath & Moreau 1966). Jones (1972) quotes I. Abbott, who considers that they are in fact the more widespread mainland species, *A. pusilla,* which also occurs in Tasmania and on King Island, and *S. frontalis.* He considers that *S. humilus* is possibly 'not a good species, in which case variation of *Sericornis* over south-east Australia and Bass Strait is clinal . . . the Deal Island population is intermediate in many respects between the Victorian and Flinders Island populations'.

Where the island populations are not intermediate in characteristics, but are similar to the Tasmanian forms, then they may in fact be good species on the islands and in Tasmania. A possible example of this is the population on Hogan Island, to the northwest of the Kent Group, of *Rattus lutreolus* which is the Tasmanian subspecies *R. l. velutinus.* Specimens collected there differ significantly from the Tasmanian population in only one cranial measurement, interorbital width, the Hogan Island rats being somewhat

smaller (Wakefield 1969). Since this population must have maintained itself distinct from the mainland population at about the line of contact, just N. of the Hogan Group, during the existence of the land bridge, it is likely that the Tasmanian and island rats are a good species.

Some further differentiation may have occurred in the island populations since the land bridge was finally flooded, as in the populations of *Potorous apicalis* in the Furneaux Group; this may account for the additional island subspecies that have been named, such as the two forms of *Macropus rufogriseus*, and the Flinders Island population of the ringtail possum. Further studies on the variation of island populations are needed; particularly, attempts to distinguish persisting variation that is due to interbreeding between Tasmanian and mainland populations on the land bridge during the Pleistocene, from variation that is due to the isolation of small populations on the islands over the last 10,000 years.

If a species that evolved in Tasmania did not meet any resistance from the mainland fauna, it may have been able to invade the mainland and become established there. There are three obvious possibilities among the mammals, *Antechinus minimus*, *Thylogale billardierii* and *Perameles gunnii*. *Antechinus minimus* has the barest foothold on the Victorian coast (Wakefield & Warneke 1963) and has been just as restricted in its past distribution, at least during postglacial times, as it is not recorded from any Victorian cave deposits (e.g. Wakefield 1964, 1967a, 1967b). Similarly, *Thylogale billardierii*, which has become extinct on the mainland during historical times, is recorded there during the late Pleistocene and Recent only from cave deposits close to the Victorian coast, such as McEacherns Cave and Fern Cave on the lower Glenelg River, and Tower Hill Beach and Bushfield (Wakefield 1964, 1967a, 1967b). *Perameles gunnii* has a wider distribution than these two species, but has been recorded only from western Victoria. Littlejohn (1967) lists several amphibian species that he suggests evolved in Tasmania and migrated north onto the mainland.

Some species widespread on the mainland may have been absent from Tasmania until the Late Pleistocene land bridge allowed them to move south. Most in this category would be those species in which the island and Tasmanian populations do not differ from the mainland ones. Within Tasmania there are several examples of closely related species pairs, one of which presumably evolved there during an earlier period of isolation, while the other moved south over a later land bridge. In these cases, the endemic species or the more distinctive (and presumably the older) of two endemics is usually the only one found on the islands or is the more common on the islands. For example, Ewings Thornbill, *Acanthiza ewingii* is endemic to Tasmania, but is also found on King and Flinders Islands (Ridpath & Moreau 1966). The related Brown Thornbill, *A. pusilla diemensis*, an endemic subspecies in Tasmania, has been recorded in Bass Strait only from King Island, where it is much rarer than *A. ewingii* (Green & McGarvie 1971). Similarly, of the two endemic currawongs found in Tasmania, *Strepera fuliginosa* and *Strepera arguta*, only the more highly differentiated, *Strepera fuliginosa*, has been recorded from the islands, where it is found on both King and Flinders (Serventy 1967). No exact parallel occurs in the mammals, but the species pair of *Antechinus minimus* and *A. swainsonii* is comparable. *Antechinus minimus*, though not endemic to Tasmania, may have originated there, as on the mainland it is restricted to a few isolated localities on the southern coast of Victoria (Wakefield & Warneke 1963). In contrast, *A. swainsonii* is widely distributed in coastal New South Wales and Victoria. Yet only *A. minimus* is found on the Bass Strait islands. In the case of the birds, the species more widespread on the islands is living there in a habitat inconsistent with that which it favours in Tasmania. Both *Acanthiza ewingii* and *Strepera fuliginosa* are found only in wet sclerophyll habitats in Tasmania, while the species rare or missing from the islands, *A. pusilla* and *S. arguta* occur in dry sclerophyll areas. Yet on the islands *A. ewingii* and *S. fuliginosa* are found in these drier habitats. This parallels the distribution of some mammals as mentioned earlier, where *Potorous apicalis*, *Isoodon obesulus* and *Dasyurus maculatus*, all of which prefer wetter habitats, are living on the islands while the similar species, *Bettongia gaimardi*, *Perameles gunnii* and *Dasyurus viverrinus*, found in drier habitats in Tasmania, are absent. In contrast, *Antechinus swainsonii*, which is not found on the islands, inhabits rainforest in Tasmania, while *A. minimus*, the island representative of the pair, prefers open unforested areas and is found in Tasmania's buttongrass plains and coastal sedgelands.

Some species have moved south into Bass Strait but have not reached Tasmania. Green and McGarvie (1971) noted that several birds reach the southern limit of their range at King Island, and one does so at Flinders Island. Among the mammals only extinct species, such as *Diproto-*

don optatum on King Island and *Aepyprymnus rufescens* on Flinders Island have been recorded from the mainland and the islands, but not from Tasmania. But in these cases, their apparent absence from Tasmania could be due to the poor state of knowledge of the Tasmanian fossil record.

There are several mainland species of mammals which, considering their distribution and habitat, could be expected to have moved into Tasmania at the same time of the land bridge but apparently did not do so. Parallel cases among reptiles and amphibians have been explained as postglacial intrusives, that is, species which had more northerly distributions on the mainland during the Pleistocene, and which did not move into southern Victoria until the connections across Bass Strait had been severed (Rawlinson 1967, Littlejohn & Martin 1966). All the mammal species cannot be accounted for in this way, as some, such as the koala, *Phascolarctos cinereus* and the swamp wallaby, *Wallabia bicolor*, are found in late Pleistocene and Recent deposits throughout southern Victoria, and suitable habitats for these species now exist in Tasmania and on the islands. It is possible that some of these species reached Tasmania, or at least moved south onto the land bridge during the Pleistocene and later died out. Like *Aepyprymnus rufescens*, they may yet be found as fossils within Tasmania or on the islands.

ACKNOWLEDGMENTS

This study formed part of a thesis submitted for the degree of Doctor of Philosophy at Monash University. A grant from the M. A. Ingram Trust covered the expenses of field work and radiocarbon dates.

Information and material was generously made available by Mr P. Aitkin, South Australian Museum; Miss J. Dixon and Mr T. Darragh, National Museum of Victoria; Mr R. H. Green, Queen Victoria Museum, Launceston; and Mr B. Marlow, Australian Museum. I would particularly like to thank Professor J. W. Warren for his guidance and criticism; Mr. J. H. Calaby, and Mr N. A. Wakefield for their invaluable information and advice, and Dr S. Murray-Smith, who made available the subfossil collections from Erith Island. I am also grateful to Dr E. Guiler, University of Tasmania; Mr M. Plane, Bureau of Mineral Resources, Canberra; Mr L. Sutherland, Tasmanian Museum, Hobart; and Mr J. Whinray, Flinders Island.

I am indebted to the people of the islands, particularly Mr and Mrs A. Dart, Mr and Mrs N. McQueen and Mr and Mrs E. Warren of Flinders Island; and Mr and Mrs A. M. McGarvie of King Island, for their hospitality and assistance. Mr F. Goold of Port Albert, Victoria, and Mr R. Munro of Launceston provided transport to some of the more remote islands. The Animals and Birds Protection Board of Tasmania kindly granted me permits to collect on the islands and in Tasmania. Finally, I would like to thank the many people who assisted with the cave excavation, the subfossil collections and the trapping programme.

REFERENCES

Alliston, E., 1966. *Escape to an island.* Melbourne: Heinemann.

Anderson, C., 1932. Paleontological notes no. III. The skull of *Sthenurus occidentalis* Glauert. *Rec. Aust. Mus.* 18: 383-387.

Anderson, W., 1914. Note on the occurrence of the sand-rock containing bones of extinct species of marsupials (emu, kangaroo, wombat, etc.), on King Island, Bass Strait, Tasmania. *Ibid.* 10: 275-283.

Ashby, E., 1927. Islands in Bass Strait upon which kangaroo and wallaby are found. *Trans. R. Soc. S. Aust.* 51: 414.

Ashworth, H. P. C. & Le Souef, D., 1895. Albatross island and the Hunter Group. *Vict. Nat.* 11: 134-144.

Atkinson, E. D., 1890. Notes of a short trip to the islands of western Bass Straits. *Ibid.* 6: 156-164.

Backhouse, J., 1843. *A narrative of a visit to the Australian colonies.* London: Hamilton, Adams & Co.

Barrett, C., 1909. Island Life. Birds and man is Bass Strait. *Life*, August.

————, 1939. *Koonwarra: A naturalist's adventures in Australia.* London: Oxford University Press.

————, 1944. *Isle of mountains.* Melbourne: Cassell.

Barrett, J. W., 1918. *The Twin Ideals. An educated Commonwealth.* 2 Vols. London: H. K. Lewis and Co.

Brazenor, C. W., 1934. A new species of mouse, *Pseudomys (Gyomys)*, and a record of the broad-toothed rat, *Mastacomys*, from Victoria. *Mem. natn. Mus., Melb.* 8: 158-161.

Brownrigg, M. B., 1872. *The cruise of the 'Freak'.* Launceston.

Bureau of Meteorology. (1954). *Climate of Flinders Island.* Mimeo. Melbourne.

————, 1966. *Rainfall statistics, Tasmania.* Melbourne.

Calaby, J. H., 1971. The current status of Australian Macropodidae. *Aust. Zool.* 16: 17-29.

————, & Wimbush, D. J., 1964. Observations on the broad-toothed rat, *Mastacomys fuscus* Thomas. *CSIRO Wildl. Res.* 9: 123-133.

Campbell, A. J., 1888. Field Naturalists' Club of Victoria expedition to King Island, November 1887. *Vict. Nat.* 4: 129-164.

Courtney, J., 1963. King Island, Bass Strait—the remarkable faunal unit (with description of a new form of Potorous rat-kangaroo). *Aust. Aviculr.* 17: 18-20; 92.

Coutts, P. J. F., 1967. Coastal dunes and field

archaeology in S.E. Australia. *Archaeol. phys. Anthrop. in Oceania* 2: 28-34.

Davies, J. L., 1967. Tasmanian landforms and Quaternary climates. In *Landform studies from Australia and New Guinea.* Eds. J. N. Jennings and J. A. Mabbutt. pps. 1-25. Canberra: Australian National University Press.

Dimmock, G. M., 1957. Soils of Flinders Island, Tasmania. *Soils Ld. Use Ser. CSIRO Aust.* 23.

Douglas, A. M., Kendrick, G. W., & Merrilees, D., 1966. A fossil bone deposit near Perth, Western Australia, interpreted as a carnivore's den after feeding tests on living *Sarcophilus* (Marsupialia, Dasyuridae). *J. R. Soc. W. Aust.* 49: 88-90.

Flinders, M., 1801. *Observations on the coasts of Van Diemen's Land, on Bass's Strait and its islands, and on part of the coasts of New South Wales.* London: John Nichols.

————, 1814. *A Voyage to Terra Australis.* (2 Vols. and atlas). London: G. & W. Nicol.

Gabriel, J., 1894. Report of expedition to Furneaux Group. *Vict. Nat.*, 10: 167-184.

Galloway, R. W., 1965. Late Quaternary climates in Australia. *J. Geol.* 73: 603-618.

Gill, E. D., 1967. Evolution of the Warrnambool-Port Fairy coast and the Tower Hill eruption, western Victoria. In *Landform studies from Australia and New Guinea.* Eds. J. N. Jennings and J. A. Mabbutt. pp. 341-364. Canberra: Australian National University Press.

————, 1968. Aboriginal bone implement from fossil bone bed, Tasmania. *Rec. Queen Vict. Mus.* 31.

————, & Banks, M. R., 1956. Cainozoic history of Mowbray Swamp and other areas of north-western Tasmania. *Ibid.* 6: 1-42.

Green, R. H., 1966. Notes on the lesser long-eared bat, *Nyctophilus geoffroyi*, in northern Tasmania. *Ibid.* 22.

————, 1967. The murids and small dasyurids in Tasmania. Parts 1 and 2. *Ibid.* 28.

————, 1968. The murids and small dasyurids in Tasmania. Parts 3 and 4. *Ibid.* 32.

————, 1969. The birds of Flinders Island with references to other eastern Bass Strait Islands and annotated lists of other vertebrate fauna. *Ibid.* 34.

————, & McGarvie, A. M., 1971. The birds of King Island with reference to other Western Bass Strait islands and annotated lists of the vertebrate fauna. *Ibid.* 40.

Guiler, E. R., 1953. Distribution of the brush possum in Tasmania. *Nature, Lond.* 172: 1091-1093.

————, 1967. The Cape Barren goose, its environment, numbers and breeding. *Emu,* 66: 211-235.

Heinsohn, G. E., 1966. Ecology and reproduction of the Tasmanian bandicoots (*Perameles gunnii* and *Isoodon obesulus*). *Univ. Calif. Publ. Zool.* 80: 1-97.

Hobbs, R. P., 1971. Studies of an island population of *Rattus fuscipes. Vict. Nat.* 88: 32-38.

Hope, J. H., 1969. Biogeography of the mammals on the islands of Bass Strait, with an account of variation in the genus *Potorous.* PhD Thesis, Monash University.

Iredale, T. & Troughton, E. LeG., 1934. A check-list of the mammals recorded from Australia. *Mem. Aust. Mus.* 6: 1-122.

Jackson, W. D., 1965. Vegetation. In *Atlas of Tasmania.* Ed. J. L. Davies. pp. 30-35. Hobart; Lands and Surveys Dept.

Jennings, J. N., 1959a. The coastal geomorphology of King Island, Bass Strait, in relation to changes in the relative level of land and sea. *Rec. Queen Vict. Mus.* 11.

————, 1959b. The submarine topography of Bass Strait. *Proc. R. Soc. Vict.* 71: 49-72.

————, 1961. The sealevel changes in King Island, Bass Strait. *Z. Geomorph. Suppl.* 3: 80-84.

————, 1968. Syngenetic karst in Australia. In *Contributions to the study of karst.* Ed. P. W. Williams and J. N. Jennings. pp. 41-110. Canberra: Australian National University, Department of Geography, Research School of Pacific Studies, Publication G/5 (1968).

————, 1971. Sea level changes and land links. In *Aboriginal man and environment in Australia.* Eds. D. J. Mulvaney and J. Golson. pp. 1-13. Canberra: Australian National University Press.

Jones, J., 1972. Further notes on Kent Group birds. *Vict. Nat.* 89: 223-224.

Jones, R., 1968. The geographical background to the arrival of man in Australia and Tasmania. *Archaeol. phys. Anthrop. in Oceania* 3: 186-215.

Keble, R. A., 1945. The stratigraphic range and habitat of the Diprotodontidae in southern Australia. *Proc. R. Soc. Vict.* 57: 23-48.

Kershaw, R. C. & Sutherland, F. L., 1972. Quatermary geomorphology of Flinders Island. *Rec. Queen Vict. Mus.* 43.

Langford, J., 1965. Weather and climate. In *Atlas of Tasmania.* Ed. J. L. Davies. pp. 2-11. Hobart: Lands and Surveys Department.

Lee, I., 1915. *The logbooks of the 'Lady Nelson' with the journal of her first commander Lieutenant James Grant, R.N.* London: Grafton & Co.

Le Souef, A. S., 1929. Notes on some mammals from Bass Strait islands, including a new subspecies of *Pseudocheirus. Aust. Zool.* 5: 329-332.

Le Souef, D., 1891. Expedition of Field Naturalists' Club to Kent Group, Bass Strait. *Vict. Nat.* 7: 121-131.

Littlejohn, M. J., 1967. Patterns of zoogeography and speciation in south-eastern Australian amphibians. In *Australian Inland Waters.* Ed. A. H. Weatherly. pp. 150-174. Canberra: Australian National University Press.

————, & Martin, A. A., 1965. The vertebrate fauna of the Bass Strait islands. *Proc. R. Soc. Vict.* 79: 247-256.

Lord, J. E. C., 1908. Furneaux Islands: Report upon the state of the islands . . . *Js. & Pap. Parl.* Vol. 59. Pap. no. 57.

Macintosh, N. W. G., 1949. A survey of possible sea routes available to the Tasmanian Aborigines. *Rec. Queen Vict. Mus.* 2: 123-144.

McLaren, W. D., 1966. The Flinders Island wombat. *Wildlife in Australia* 3: 110-113.

Mahoney, J. A., & Marlow, B. J., 1968. The rediscovery in New South Wales (Ku-ring-gai Chase National Park and Port Stephens) of *Pseudomys novaehollandiae* (Waterhouse, 1843) (Rodentia: Muridae). *Aust. J. Sci.* 31: 221-223.

Main, A. R., 1961. The occurrence of Macropodidae on islands and its climatic and ecological implications. *J. R. Soc. W. Aust.* 44: 84-89.

Marlow, B. J., 1957. A recent record from New South Wales of the rufous rat kangaroo, *Aepyprymnus rufescens* (Gray) (Macropodidae). *CSIRO Wildl. Res.* 2: 166-167.

————, 1958. A survey of the marsupials of New South Wales. *Ibid.,* 3: 71-114.

MARSHALL, L. G. & HOPE, J. H., 1973. A re-valuation of *Dasyurus bowlingi* Spencer and Kershaw 1910 (Marsupialia, Dasyuridae) from King Island, Bass Strait. *Proc. R. Soc. Vict.* 85: 225-234.

MERRILEES, D., 1968. Man the destroyer: late Quaternary changes in the Australian marsupial fauna. *J. R. Soc. W. Aust.* 51: 1-24.

MESTON, A. L., 1936. Observations on visits of the Tasmanian Aborigines to the Hunter Islands. *Pap. Proc. R. Soc. Tasm.* (1935): 155-162.

MULLETT, J. H., & MURRAY-SMITH, S., 1967. First footing on a Bass Strait island; and investigation of Dover Island in the Kent Group. *Vict. Nat.* 84: 239-250.

NOETLING, F., 1912. The occurrence of gigantic marsupials in Tasmania. *Pap. Proc. R. Soc. Tasm.* (1911): 124-133.

NORMAN, F. I., 1966. A note on the vegetation of Big Green Island, Furneaux Group, Tasmania. *Vict. Nat.* 83: 294-299.

————, 1971. Problems affecting the ecology of West Gippsland islands. *Proc. R. Soc. Vict.* 84: 7-18.

OXLEY, J., 1810. Remarks on the settlement of Port Dalrymple: Islands adjacent to Port Dalrymple, Bass's Straits. *Hist. Rec. Aust.* Series 3, Vol. 1: 774-777.

PEARSON, J., 1938. The Tasmanian brush possum: its distribution and colour variety. *Pap. Proc. R. Soc. Tasm.* (1937): 21-30.

PÉRON, F., & FREYCINET, L de, 1807-1816. *Voyage de découvertes aux Terres Australes, exécuté sur les corvettes le Géographe, le Naturaliste, et la goëlette le Casuarina, pendant les années 1800, 1801, 1802, 1803 et 1804; sous le commandement du capitaine de vaisseau Nicholas Baudin.* 3 vols. Bertrand. Paris.

PLOMLEY, N. J. B. (Ed.), 1966. *Friendly mission. The Tasmanian journals and papers of George Augustus Robinson, 1829-34.* Hobart: Tasmanian Historical Research Association.

PRYOR, R. J., 1967a. Problems of rural land development, Flinders Island, Tasmania. *Aust. Geogr.* 10: 188-196.

————, 1967b. An evaluation of land development, Flinders Island. *Proc. R. Soc. Vict.* 80: 201-210.

PULLAR, E. M., 1953. The wild (feral) pigs of Australia: their origin, distribution and economic importance. *Mem. natn. Mus., Vict.* 18: 7-23.

RAWLINSON, P. A., 1967. The vertebrate fauna of the Bass Strait islands. 2. The Reptilia of Flinders and King Islands. *Proc. R. Soc. Vict.* 80: 211-224.

RIDE, W. D. L., 1970. *A guide to the native mammals of Australia.* Melbourne. Oxford University Press.

RIDPATH, M. G., & MOREAU, R. E. 1966. The birds of Tasmania: ecology and evolution. *Ibis,* 108: 348-393.

SCOTT, H. H., 1905. Memoir on *Macropus anak*, a fossil kangaroo from King Island. *Queen Vict. Mus. Launceston Brochure.*

————, 1906. Memoir on *Procoptodon rapha* (Owen) from King Island. *Ibid.*

————, 1912. Memoir on *Nototherium tasmanicum* (Owen). *Ibid.* 4.

————, 1915a. A monograph of *Nototherium tasmanicum, Rec. Geol. Surv. Tasm.* 4: 1-47.

————, 1915b. Some notes on the humeri of wombats. *Queen Vict. Mus. Launceston Brochure* 5.

————, 1917. Some palaeontological notes. *Ibid.* 6.

————, 1927. The story of the Nototheria. *Aust. Mus. Mag.* 3: 24-25.

————, & HARRISSON, K. M., 1911. On the discovery of a *Nototherium* in Tasmania, with notes upon the locality of the discovery. *Tasm. Nat.* 2: 61-63.

————, & LORD, C. E., 1921a. Studies in Tasmanian mammals, living and extinct. I. *Nototherium mitchelli.* (A marsupial rhinoceros). *Pap. Proc. R. Soc. Tasm.* (1920): 13-16.

————, & ————, 1921b. Studies in Tasmanian mammals, living and extinct. II. The history of the genus *Nototherium. Ibid.* (1920): 17-32.

————, & ————, 1921c. Studies in Tasmanian mammals, living and extinct. III. *Nototherium mitchelli.* Its evolutionary trend—the skull, and such structures as related to the nasal horn. *Ibid.* (1920): 76-96.

————, & ————, 1921d. Studies in Tasmanian mammals, living and extinct. IV. *Nototherium mitchelli.* Appendicular skeleton, including the manus and pes (hitherto unknown). *Ibid.* (1920): 97-113.

————, & ————, 1922a. Nototheria and allied animals—a rejoinder. *Ibid.* (1921): 1-5.

————, & ————, 1922b. Studies in Tasmanian mammals, living and extinct. IV. The cave deposits at Mole Creek. *Ibid.* (1921): 6-8.

————, & ————, 1922c. Studies in Tasmanian mammals, living and extinct. V. *Zaglossus harrissoni*, sp. nov. *Ibid.* (1921): 13-15.

————, & ————, 1923. Studies in Tasmanian mammals, living and extinct. VII. A note on the turbinoid cells and allied data of *Nototherium mitchelli.* Ibid. (1922): 23-24.

————, & ————, 1924b. Studies in Tasmanian mammals, living and extinct. VIII. Pleistocene marsupials from King Island. *Ibid.* (1923): 1-3.

————, & ————, 1924b. Studies in Tasmania mammals, living and extinct. IX. *Nototherium victoriae*, Owen. *Ibid.* (1923): 4-5.

————, & ————, 1924c. Studies in Tasmanian mammals, living and extinct. X. Giant wallaby, *Macropus anak* Owen. *Ibid.* (1923): 6-8.

————, & ————, 1924d. Studies in Tasmanian mammals, living and extinct. XI. Notes on a mutilated femur of *Nototherium*. Ibid. (1923): 56-57.

————, & ————, 1925a. Ear bones of Nototheria and allied animals. *Ibid.* (1924): 1-7.

————, & ————, 1925b. Studies in Tasmanian mammals, living and extinct. XII. On certain Tasmanian Pleistocene marsupials. *Ibid.* (1924): 53-58.

————, & ————, 1926. Tasmanian giant marsupials. *Ibid.* (1925): 1-4.

SCOTT, T., 1828. *Furneaux's isles. A short geographical memoir thereof.* Mitchell Library, A606.

SEEBECK, J. H., & BESTE, H. J., 1970. First record of the New Holland mouse in Victoria. *Vict. Nat.* 87: 280-287.

SERVENTY, D. L., 1967. The Bass Strait islands. *Aust. nat. Hist.* 15: 401-408.

S. H., 1883. Visit to the islands in Bass Straits. *Launceston Examiner*, 26 May.

SHARLAND, M., 1962. *Tasmanian wild life.* Melbourne: Melbourne University Press.

SHILLINGLAW, J. J. (Ed.), 1879. *Historical records of Port Phillip.* Melbourne: Government Printer.

SPENCER, B., & KERSHAW, J. A., 1910a. A collection of subfossil bird and marsupial remains from King Island. *Mem. natn. Mus., Melb.* 3: 5-36.

————, & ————, 1910b. The existing species of the genus *Phascolomys*. *Ibid.* 3: 37-63.

STEPHENS, C. G., & HOSKING, J. S., 1932. Soil survey of King Island. *CSIR Bull.* 70.

STIRTON, R. A., 1967. New species of *Zygomaturus* and additional observations on *Meniscolophus*, Pliocene Palankarinna fauna, South Australia. *Bull. Bur. Miner. Resour. Geol. Geophys. Aust.* 85: 149-160.

STOKES, J. L., 1846. *Discoveries in Australia; with an account of the coasts and rivers explored and surveyed during the voyage of H.M.S. 'Beagle' in the years 1827-38-39-40-41-42-43.* 2 Vols. London: T. and W. Boone.

SUTHERLAND, F. L., & KERSHAW, R. C., 1971. The Cainozoic geology of Flinders Island, Bass Strait. *Pap. Proc. R. Soc. Tasm.* 105: 151-175.

TATE, G. H. H., 1945. Results of the Archbold Expeditions No. 54. The marsupial genus *Pseudocheirus* and its subgenera. *Amer. Mus. Nov.* 1287: 1-29.

TEDFORD, R. H., 1966. A review of the macropodid genus *Sthenurus*. *Univ. Calif. Publ. Geol. Sci.* 57: 1-72.

THOMAS, O., 1888. *Catalogue of the Marsupialia and Monotremata in the collection of the British Museum.* London: Taylor and Francis.

VICTORIA. DEPARTMENT OF PUBLIC WORKS. 1970. *Sailing directions Victoria including Bass Strait.* 7th Ed. Melbourne: Government Printer.

WAKEFIELD, N. A., 1964. Recent mammalian subfossils of the basalt plains of Victoria. *Proc. R. Soc. Vict.* 77: 419-425.

————, 1967a. Preliminary report on McEachern's Cave, S.W. Victoria. *Vict. Nat.* 84: 363-383.

————, 1967b. Mammal bones in the Buchan district. *Vict. Nat.* 84: 211-214.

————, 1969. An investigation of late Pleistocene and Recent cave deposits in south-eastern Australia M.Sc. Thesis, Monash University.

————, 1972. Studies in Australian Muridae: Review of *Mastacomys fuscus*, and description of a new subspecies of *Pseudomys higginsi*. *Mem. nat. Mus., Vict.* 33: 15-31.

————, & WARNEKE, R. M., 1963. Some revision in *Antechinus* (Marsupialia) 1. *Vict. Nat.* 80: 194-219.

WHINRAY, J. S., 1971a. The present distribution of some mammals in the Furneaux Group, Bass Strait. *Ibid.* 88: 279-286.

————, 1971b. A list of birds of the Major Kent's Group Islands. *Tasm. Nat.* 24: 2-3.

————, 1972. Notes on West Sister Island, Furneaux Group Tasmania. *Vict. Nat.* 89: 4-15.

WHITE, S. A., 1909. Narrative of the expedition promoted by the Australasian Ornithologists' Union to the islands of Bass Strait. *Emu* 8: 195-207.

WILLIS, J. H., & SKEWES, C. I., 1955. Robert Brown's Bass Strait journal of April/May 1802. *Muelleria* 1: 46-50.

WOOD JONES, F., 1924. *The mammals of South Australia.* Part 2. Adelaide: Government Printer.

WOODS, J. T., 1958. The extinct marsupial genus *Palorchestes* Owen. *Mem. Qld. Mus.* 13: 177-193.

————, 1962. Fossil marsupials and Cainozoic stratigraphy in Australia: a review. *Ibid.* 14: 41-49.

————, 1968. The identity of the extinct marsupial genus *Nototherium* Owen. *Ibid.* 15: 111-116.

WYRTKI, K., 1960. The surface circulation in the Coral and Tasman Seas. *Tech. Pap. Div. Fish. Oceanogr. CSIRO Aust.* 8.